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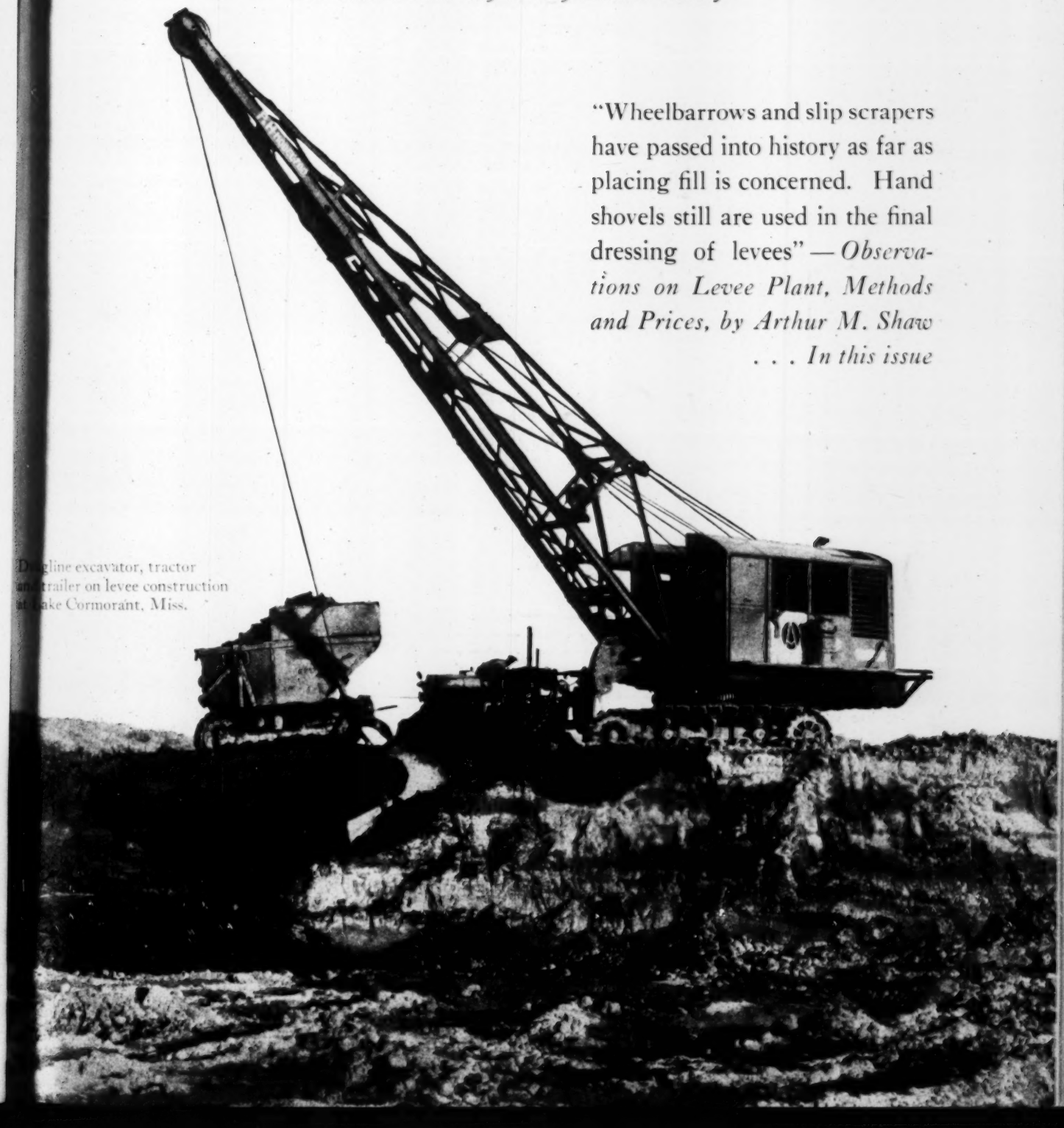

"Wheelbarrows and slip scrapers have passed into history as far as placing fill is concerned. Hand shovels still are used in the final dressing of levees" — *Observations on Levee Plant, Methods and Prices, by Arthur M. Shaw*

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NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn Street
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(*Published in London*)

SUBSCRIPTION PRICES: United States and its possessions, Canada, Mexico, and other countries taking domestic postage rates, $5 a year. All other foreign countries, $9 a year. Single copy, 25 cents. Published weekly. Entered as second class matter, April 11, 1917, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

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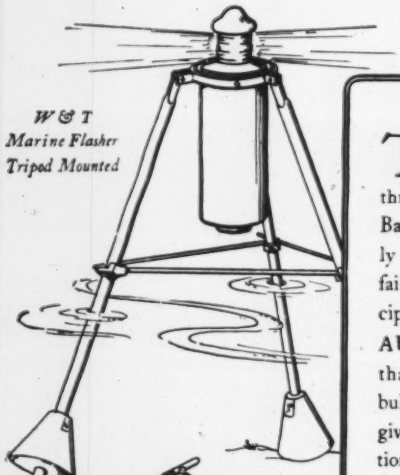

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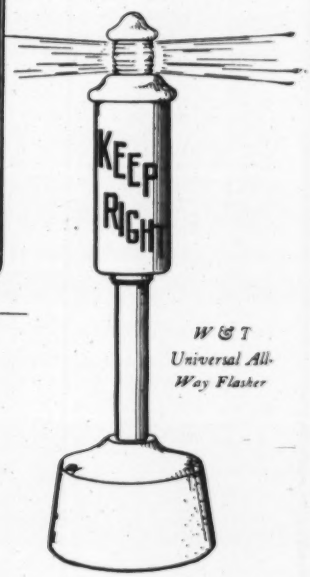

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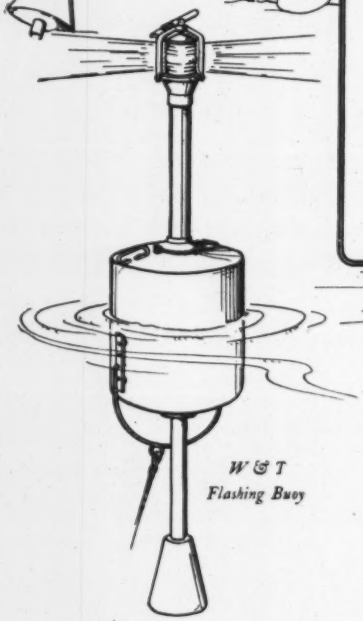

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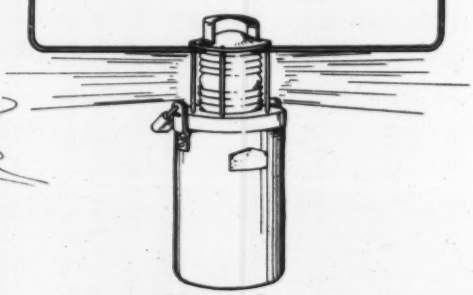

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Volume 102 NEW YORK, FEBRUARY 21, 1929 Number 8

Central Supply Problems

FURTHER data bearing on the subject of central concrete supply from commercial mixing plants were brought out in two interestingly different discussions at the meeting of the American Concrete Institute last week. Certain conclusions from practice in Pittsburgh and elaborate tests of retempered concrete lay stress on the large possibilities of such central supply and at the same time give renewed warning as to some of its difficulties. The Pittsburgh report of P. J. Freeman indicates that such supply is highly successful under careful control and requires no such narrow limitation as 45 minutes from mixing to placing. At the same time it is a reminder of the chance of segregation leading to necessity for remixing if mixtures and control are not thoroughly adjusted. From the laboratory data set forth by H. F. Gonnerman it follows that unexpectedly great latitude in the handling of concrete is permissible, but again on the basis of careful control only. With periods up to six hours between time of mixing and time of placing, satisfactory results were attained by restoring the workability of the mixture; and, a most enlightening fact, under these conditions the properties of the final concrete were in remarkably close accord with the famous water-cement curve. Thorough comprehension of these facts can serve to further the practice of central concrete supply very greatly. With continuous control to give it the absolutely necessary dependability, it provides a highly flexible and adaptable aid to engineering operations. How fully this close control can be assured is the most important remaining problem.

Chicago's Garden City Suburb

ENGINEERS seldom have a chance to lay out even a small city in advance of its construction; almost never a large one. How such an opportunity is being utilized near Chicago for the city of Westchester, with a prospective population of 98,000, is told elsewhere in this issue. This new settlement may be classed as a garden city at least by virtue of the exclusion of all industry, the allowance of only enough business property to serve local needs, and the fact that with 2,200 acres for 98,000 population the density of population will average only some 45 persons, or eight to ten families per acre. The article, which, save for a general outline of the city plan, is chiefly devoted to the sewerage and drainage works now under construction, makes clear how nearly in other respects than those just noted Westchester will conform to the ideal garden city. Aside from a forest preserve (presumably a Cook County area) bordering one corner, the article gives no indication that the new city will not soon be surrounded by the ordinary suburban type of speculative real estate development. Only a small park area is shown on the plan, but possibly more parks are proposed in the large unplotted areas shown on the city plan. The street layout varies in a number of places from the gridiron plan which makes for dreary sameness in so many cities. Such getting away from the gridiron as occurs appears to have been dictated chiefly by railway lines. Presumably the town layout was largely dominated by the early land subdivision system adopted years ago. The entire conception of Westchester, Ill., is in striking contrast with that of Radburn, N. J. (see *Engineering News-Record*, Feb. 16, and March 15, 1928, pp. 293 and 426). To begin with, Radburn is planned as a relatively small, self-contained city of only 25,000 people, and though in the New York-Jersey metropolitan district and close by Paterson and Passaic, it will have its own industries. With a townsite of 1,000 acres, Radburn will have a population density of only 25 per acre, compared with the 45 projected for the Chicago suburb. The residence section of Radburn is uniquely designed to place every house in a parked area and give children access to the schools without stepping on traffic streets. This is getting far away from the gridiron street and block layout of Westchester. The contrasts are mentioned factually, not by way of invidious comparison. Every town plan should conform to local conditions, shaped as far as may be by the ideals of the founders—a shaping difficult if not impossible except when towns are laid out in open country, as these two are. More ventures of the sort with variations to meet local conditions, imposed by nature and shaped by man, are to be hoped for. May they be crowned with success!

Reinforced Brickwork

WIDE variations in the relative cost of labor and material in different countries result in an equally wide variation in construction practices. In countries where labor is cheap and materials costly an amount of laborers' effort may be expended to reduce the amount of expensive material going into a structure which would not be warranted in this country. This may well be the reason why reinforced brickwork, extensively used in India, as described in this issue, has not been used more widely in this country. It would appear, however, that such brickwork has possibilities for use here which have not been fully appreciated. Where cost is the controlling item probably reinforced concrete can show economies, but where appearance or insulation are factors reinforced brickwork has much in its favor. An extension of the tests made at the University of Missouri should give results of value in determining both the possibilities and the limitations of this form of construction.

Today and Tomorrow

TODAY'S refuse will be utilized tomorrow and thereby not only money saved but nuisance stopped and perchance menace to life and property ended. Such has been the experience in many fields of industry. It is bound to continue. A promising indication of such a continuation is afforded by the report on disposal of

crank-oil wastes at public garages, abstracted in this issue. As yet, practice in this respect is largely unregulated, despite the existence of more or less well-drawn city ordinances. There are a growing number of instances where safety and economy are being effected by systemized collection, removal and reclamation of crank-oil wastes. Recommendations for both the control and the utilization of these wastes in the District of Columbia, resulting from the report already mentioned, are awaiting action by those in authority. It is to be hoped that they will be adopted. The seat of our national government is the very place to set the example in this and many other administrative reforms.

Contracting Calls to Engineering

A NOTABLE year of progress in stabilizing contracting is being reviewed this week in Chicago by leading contractors from all parts of the United States. The occasion is the tenth annual convention of the Associated General Contractors of America. They are reviewing twelve months of work which is of greater import in the construction business than any other action of associated contracting since its original creative act of organizing and becoming articulate ten years ago. It commands the regard and co-operation of engineers and architects and all the business agencies that serve construction.

In twelve months definite progress has been made in affiliating with contracting the various agencies which serve it, in a forceful and clearly determined offensive for more exacting credit practices. Contracting has grown up on the policy of credit extension by lenders of money, makers of construction equipment and venders of building materials. In the fierce competition of an enormously increased construction program it has been granted credit too freely. It has become infected and weakened by this indulgence. It has to return to sterner practices or it will die. This return is being undertaken and those who are agents for contracting engineering works can speed the journey.

In their association work for improved credit practices contractors have seen, first, that they must sacrifice by urging tighter and more exacting credit terms than they have been freely receiving, and second, that they must affiliate with themselves as association bureaus the other agencies of construction. In a year they have laid down the schedule of harder credits and they have opened the way for affiliation. The task now is to get agreement and affiliated action by those who award contracts and by the banks, bonding companies, equipment manufacturers, materials producers and venders who service construction.

There has been progress. Public-works bodies are beginning to require prequalification of bidders. A large fraction of the surety bonding companies have formed an affiliated bureau. The banking interests are beginning to adopt the standard financial, experience and equipment questionnaires advocated by contracting. Manufacturers and dealers in equipment and materials are here and there in groups and individually affiliating themselves with the movement. All these activities evidence progress, but they do not represent sufficient progress. Here is where the engineer and architect and public-works official can come into the movement and exert a powerful influence by demanding the higher standards of business and service that contractors are working to develop through credit reform.

It is plain enough that all contractors are not pointing their practices toward the higher standards and that many will never conform to them. This should not be a reason for holding back. Engineers and architects and public-works officials do not all hold to equally high business aspirations. In the majority they do and so will contracting when its business is set in order by the elimination of the unsound elements which false credit practices are helping to maintain. There is a very decided gain to engineering in the work that associated contractors are undertaking to do and it deserves more than the rather complacent approval which has been accorded to it.

Signs of Growth

LOOKING back some years one may recall a general tendency to believe that concrete is concrete—that when cement is mixed with water and inert granular materials it will produce a uniform and always dependable product. In recent times this view has been losing currency. Today it is widely admitted that there is bad as well as good concrete and (perhaps less widely) that sometimes bad concrete is produced when the intent was to make good concrete. When this new attitude of mind is supplemented by an active questioning of the adequacy of present knowledge and practice, definite progress will be near at hand. Evidence is appearing that the process of questioning has already begun.

In a stimulating address to the American Concrete Institute last week President Edward D. Boyer uttered a warning against the feeling of contentment which holds "that all that is to be learned has been learned and that the book shall now be closed." This wise remark comes as a useful supplement to the critical analysis of current methods presented by Nathan C. Johnson in the article whose concluding chapter is published in this issue. The drift toward new, aggressive thinking which speaks out of these statements is confirmed further by the studies of concrete durability reported at last week's meeting. They represent the first stage of what should develop into an aggressive attack on the problem of concrete deterioration. Its possibilities are already apparent in the findings of R. B. Young and others as to the vital influence of certain construction practiced.

With the present decade concrete as a widely used building material may be said to be something over 30 years old. A wealth of object lessons is therefore available to show how it acts under the many kinds of chemical, mechanical and thermal attacks to which it is subject. The truth is that such object lessons have been available in adequate number for at least fifteen years and that the present campaign of study comes late; but if late, the more reason that it should be prosecuted with energy and broadest possible co-operation. The necessary co-operation has been lacking in the concrete field partly because makers and users of concrete have not grouped themselves in a single craft conscious of their joint problems. Fortunately the movement of the present is toward more effective union of these separated interests, a development of profound importance to the future of concrete.

If the teachings of existing structures are obscured by the many variations of practice which marked the work of 30 years, more intensive laboratory investigation can help to remove some of the obscurity. There is, in fact, even greater opportunity in this field than in that of structure studies, for only in the laboratory is it possible to control conditions and obtain quantitative

comparison, whether of materials or of methods. Even though concrete has already enjoyed more extensive laboratory study than any other material which man has put to use, only a beginning has yet been made. The coming period offers even greater challenge to the laboratory investigator than to the student of field concrete.

How efficient a servant we can make of concrete depends on the insight and diligence applied to these coming researches. In the past we have succeeded in using the material with an efficiency truly remarkable for its time, making possible the creation of structures of new kind and the satisfaction of many human requirements that could not otherwise have been met. If the far wider possibilities of the future are to be realized, it can only be through efficiency of a higher order. Progress toward this greater efficiency appears to be just beginning.

Highways Not Port Facilities

THE states of New York and New Jersey stand at the parting of the ways in the matter of interstate highway connections at New York. Bills have been introduced into the New York State Legislature providing for the construction of additional vehicular tunnels under the Hudson River by both the Port of New York Authority and jointly by the two state bridge and tunnel commissions, and similar legislation is under consideration in New Jersey. While there is some evidence of need for an additional tunnel in the steady increase of traffic through the Holland tunnel, the present proposals are not so much the outgrowth of that need as of jealousy between the two bodies by which the new tunnel is proposed to be built. This condition is inexcusable. The two states must put an end to it by making a definite decision as to how and by what agency future highway connections are to be built.

The Holland tunnel was built by the bridge and tunnel commissions of the two states, jointly, under specific authority given them in 1919 after a number of years spent in studying the need for bridges or tunnels. Under like circumstances the New Jersey commission, jointly with one from Pennsylvania, built the Philadelphia-Camden bridge. These commissions had no authority to issue bonds; they depended upon the state legislatures for appropriations.

Meanwhile the Port of New York Authority was set up by the states of New York and New Jersey *for the development of the port* along very definite lines laid down in a so-called "comprehensive plan." It was given powers to acquire and own property and to issue bonds against the property as security.

The first few years of the Port Authority's life went by without its being able to accomplish much toward putting the "comprehensive plan" into effect, because of the difficulties incident to its establishment, its lack of property upon which to begin to build up a financial structure and the unconvincing nature of the "plan." Then the demand for interstate bridges between Staten Island and the mainland of New Jersey reached a point where action was needed, and the state legislatures, looking for a convenient way to finance such great bridges, seized upon the idea of using the Port Authority's bonding powers for that purpose and passed legislation authorizing the Port Authority to build two bridges. The Port Authority itself was more than willing to undertake the work in order to obtain some tangible assets. The turning over to it of the construction of the Hudson River bridge and the Kill van Kull bridge followed naturally. Both moves were simply those of expediency, there being nothing in the Port Authority's "comprehensive plan" which could possibly be construed as authorizing it to build highway bridges.

Without doubt, bridges and vehicular tunnels across the Hudson River help to facilitate the interchange of freight within the port district, but they are no more port facilities than are the streets of Manhattan. They are highways, and as such they should be operated as part of the states' highway systems exclusively. The bridges which the Port Authority is now building do not belong to the states of New York and New Jersey nor will they revert to the states when the bonds issued to build them are paid off. They are and will continue to be the property of the Port of New York Authority, and as such may in the future be used as security to raise funds for other purposes unrelated to the states' highway systems. The construction of interstate bridges or tunnels presents certain difficulties, but not so great as to warrant segregating them permanently.

This turning over of purely highway structures to the Port Authority as assets upon which it may raise money to finance the construction of port facilities is fundamentally wrong. If the facilities which it proposes to build cannot be financed on their own prospects of earnings, then they are not worth building. To permit the Port Authority to use the earning power of toll bridges to finance their construction is simply making it possible for it to construct port facilities of doubtful value. The integrity of the Port Authority or its ability to refund the bonds which it has issued is not in question, nor is the ability of its engineers as bridge builders. The latter have made a record for speed and economy of construction which both they and the Port Authority may justly be proud. The question is one of broad policy toward structures which are primarily interstate highways.

There is nothing to prevent the building of additional vehicular tunnels or bridges in the same way in which the Holland tunnel was built, using funds appropriated by the two states, but a more economical way would be to set up a single interstate body with financing powers similar to those of the Port Authority. This body could issue its own bonds, build the structures, which, when the bonds have been retired, could be made free or be operated at minimum tolls to cover the maintenance costs. The advantage of such a plan over direct state financing is that the interstate body will be compelled to make the same accurate estimates of cost that a private corporation would make before selling its bonds and would have to keep its construction cost within those limits. Moreover, if the public will not buy the bonds there is clear indication that the proposed structure is of doubtful value.

All future interstate bridges or tunnels should be similarly financed and built, and those now under construction should be divorced from Port Authority control as soon as that can be done without impairment of the Port Authority's financial status. The Port Authority has a gigantic task before it to develop ports. Its energies should not be diverted to building bridges or tunnels, nor to the development of suburban transit facilities, as has recently been proposed. They should be concentrated upon the task of cutting down freight-handling costs within the port area and the improvement of its shipping and rail facilities.

Observations on Levee Plant, Methods and Prices

Records of a Journey by an Earth-Moving Engineer Along the Mississippi Levee Operations, With Some Comment on New Sections, Construction Conditions and Future Practices

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

A RECENT trip over the Mississippi levees between New Orleans and Memphis gave an opportunity to observe practices, methods and plant. These notes indicate the impressions gained. They are not a record of all operations; only a few of the many were visited, but these few were representative. The inspection included also both the oldest and the newest earth-moving methods so that matters of obsolescence and comparison could be considered.

Levee Design and Structure

Levee building on the lower Mississippi River has undergone a great change. It includes not only the design and construction of higher levees, generally with flatter slopes, but also greater care in the selection and placing of material, the location of new levees and the maintenance of a suitable batture by requiring that wide berms be preserved and that borrow shall be restricted to moderate depths at points near the levee.

Levee Sections—A standard levee for all the materials encountered in the delta region is not practicable. A section ample to prevent seepage if built of the heavy soil known locally as "buckshot" is inadequate if constructed of soil containing a large proportion of sand. Tests made to determine the angle of seepage in three typical soils have therefore resulted in adopting "tentative" sections, which, as applied to a levee 26 ft. high, are as follows:

Material	Assumed Seepage Angle	River Slope	Crown, Ft.	Land Slope	Base, Ft.
Buckshot 75 per cent	1 on 6	1 on 3	10	1 on 5	218
Loam	1 on 6½	1 on 3½	10	1 on 6	257
Sand 75 per cent	1 on 8	1 on 5	12	1 on 7	324

Note: These are virtually the sections shown in *Engineering News-Record*, Jan. 17, 1929, p. 92.

Levee Location—New levees generally are built sufficiently remote from the river to leave a wide batture

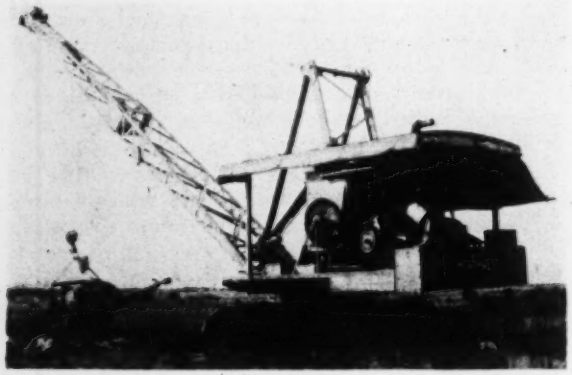


FIG. 1—DRAGLINE THROWING UP RETAINING DIKES FOR HYDRAULIC FILL

After hydraulic fill is completed the dragline with its 40-ft. boom shapes the levee. It also acts as tender to the hydraulic dredge in digging locking-in and locking-out basins.

FIG. 2—DIESEL-ENGINE-OPERATED HYDRAULIC DREDGE BUILDING WHOLE LEVEE

Excavating in a pit dug in the batture. Second growth trees are cut down in advance of dredging, but dredge cuts under stumps, which are floated away or dragged out by hand. Roots cause considerable delay from stoppage of suction line.

from which material is borrowed for the fill. In some cases old levees are dug down and the material is used in the new work, supplementing this with material secured from the batture. At other points the old levee is left intact as an additional safeguard or to permit construction to continue through one high-water season. New levee primarily is considered in this article.

Construction Equipment

It was notable first of all as the trip developed that some of the old methods of levee building have gone and that others remain as supplemental methods. Special efforts were therefore made to ascertain in what way and how much the older methods were still in use.

Wheelbarrows, Scrapers and Shovels—It was found that the wheelbarrow and the slip scraper have passed into history so far as placing fill is concerned, though the slip is found occasionally at work leveling off fill placed by other equipment.

Hand shovels still are used in the final dressing of the levees, and shovel men get subcontracts for digging the muck ditches along the center line of the levee. These ditches are 5 ft. wide by 6 ft. deep; the prevailing price paid is 20c. per cubic yard. A small dragline machine would excavate these ditches at lower cost if there were enough of this special work to justify the purchase of special equipment, but in most cases observed the hand work apparently was justified. A few odd jobs keep a supply of ordinary laborers around the camp that can be called on in an emergency.

Wheeled scrapers were seen on the wagon-and-trailer jobs; they are used principally in filling small spaces and in trimming. Following a rain they are also used in the borrowpits and on the runways to skim off the top layer of slippery mud to afford better roads for tractors and mules.

Wagons and Mules—One-yard bottom-dump wagons drawn by four mules hitched abreast were found on jobs

employing tractors and trailers. The wagons were operated in the same "swing" with the tractor-drawn equipment, though when the runways were in a condition favorable to the latter the mule teams frequently were compelled to pull out of line to permit the passage of the faster traveling tractors. Little lost motion resulted from this cause, however, and no conflicts of importance were noted.

Tractor Outfits—The motor-drawn equipment most in evidence was a 7-cu.yd. bottom-dump trailer pulled by a crawler tractor. The trailers had wide-tired front wheels, with the rear axle (which carried the bulk of the weight) on a pair of crawler treads. The dumps are arranged in two pairs so that a considerable distribution of the load can be effected. On short hauls one man rides the trailer to do the dumping and to wind up the trap doors on the return trip. On long hauls men are kept on the levee to do the dumping and closing.

Self-contained units of crawler-tread trucks and dump bodies were found on one job, but the general preference appears to be for the separate tractor and trailer.

Elevating Graders—The present elevating grader is pulled by a tractor, sizes have been increased and there has been a liberal substitution of steel in place of wood. Disk plows are used when working in certain classes of material, though these are changed for the older moldboard type for other soils. On one machine the elevating mechanism was operated by an independent gasoline engine, instead of the usual rear-wheel traction drive.

Elevating graders are at their best when working in comparatively long, shallow borrowpits with moist but not wet material. Contractors using them for filling wagons and trailers quite generally agreed that with the advent of long rains and cold weather it may be necessary to change to some type of bucket-loading equipment.

Draglines—In one form or another draglines are to be seen wherever considerable work is going on. They vary from 1- to 2-yd. outfits, with 30- to 60-ft. booms, to the 6-yd. levee machines with a working radius of 150 ft. The smaller draglines are mounted on crawler treads and are used principally in loading wagons, or they serve as auxiliaries to other equipment. The heavier machines are mounted on skids and rollers or on double sets of railroad trucks. They take material directly from the borrowpit and deposit it in the levee. Fig. 1 shows a 1-yd. dragline used by Wilbanks & Pierce as an adjunct to their hydraulic equipment.

Tower Machines—Tower-and-cableway excavators are used extensively. Descriptions of these were published in *Engineering News-Record*, March 8, 1928, p. 401, and April 12, 1928, p. 592. The former article describes a cableway with 615-ft. span and the latter gives a good description of the taut-cable and the slack-cable machines.

Hydraulic Dredges—Hydraulic dredges have been used to a limited extent in the construction of levee bases and for filling both landside and riverside borrowpits, but so far as I have been able to determine the work now under way by Wilbanks & Pierce, at Onward, Miss., and at Rosedale, Miss., is the first attempt to construct an entire levee of considerable size by hydraulic fill. This company is using one 12-in. and one 10-in. dredges. Each is driven by a diesel engine, the single power unit driving the pump, cutter and auxiliary drums. Separate engines operating on the same distillate fuel drive electric lighting plants for night operation. Fig. 2 shows the 12-in. unit working near Onward, Miss.

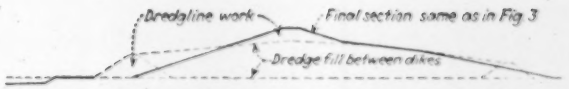


FIG. 4—DREDGE FILLS BETWEEN DIKES BUILT BY DRAGLINES, WHICH FINALLY DRESS LEVEE TO SECTION

Railway Trains—Considering the successful development of special equipment for constructing high railway fills by cars from dumping trestles, one might expect to find some of the levees constructed by this method. There was none. Where such methods would be economical, the objection to leaving temporary trestle bents in the fill prohibits their use. Even if the piles were pulled, the resulting voids would be objectionable.

There has been a limited use of railway equipment under special conditions. Last season the firm of Elkas & Weather used a light industrial railway outfit with side-dump cars for building a levee near Rosedale, Miss., and the same outfit was used at one other point. This season dump cars operating on temporary tracks are in use at Cairo, Ill., and at Lake Cormorant, Miss. These operations are described in the following section.

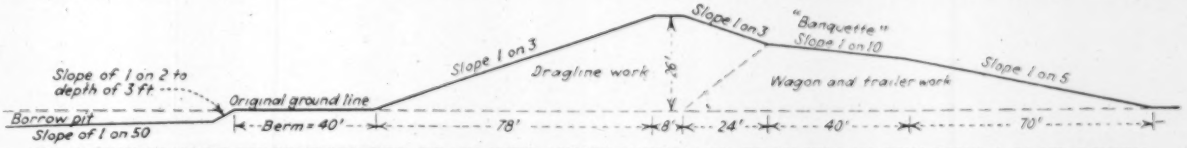


FIG. 3—DIVISION OF WORK BETWEEN DRAGLINES AND WAGONS AND TRAILERS IN BUILDING A 26-FT. LEVEE

Construction Methods

Wheeled scrapers, wagons and tractor-drawn trailers are used frequently as an adjunct to draglines, the former equipment being used to build the rear portion of the levee of material secured from the most distant portions of the borrowpit and the dragline taking material from the nearest portion of the pit and depositing it in the adjacent portion of the levee. Fig. 3 shows this method of construction.

As has been noted, the smaller draglines are used principally as an adjunct to other equipment. While the larger machines can build a levee of moderate section without rehandling material, it frequently is found more economical to rehandle once (and sometimes twice) to build a portion of the levee rather than to bring in other equipment. In rehandling the heavier soils it is necessary to keep the material as dry as possible to prevent slides in the fill. The work for which the large draglines are peculiarly fitted is the levee setback job where the bulk of the material for the new levee is near at hand.

Tower cableways cannot operate as economically as draglines in work which is well suited to the latter, but their long reach enables them to secure material from the farthest side of wide borrowpits and deposit it in the levee in one operation.

Early Dredge Work—An article by Major S. C. Godfrey, Corps of Engineers, in the *Military Engineer*, September-October, 1928, p. 416, describes the use and limitations of the large M.R.C. dredges in filling borrowpits and in building the bases of levees. These dredges are of exceptional value in emergency work, as they are fitted to

operate in the river and can excavate from the riverbed (to moderate depths) and from the banks, discharging the material either into pits or over areas to the rear of the levee. One of the most valuable types of work done by the large hydraulic dredges has been the blanketing of considerable areas on the rear of the levees to cure the sand-boil trouble which has been experienced in certain localities.

As indicating the problems of hydraulic-fill levees, at the Poydras crevasse of 1922 the contractor constructed the base of the closing levee up to water level by pumping in material secured from the batture. Great difficulty was experienced in holding the pumped material to a reasonable slope. As the material was discharged into the water it remained in suspension until it moved out to a distance of often several hundred feet from the center line. In addition to this difficulty there was an excessive subsidence of the dry fill which was placed on top of the hydraulically placed base. This dry topping was barged in and deposited by floating derricks operating grab buckets. While the difficulties encountered were great and the cost was far beyond the original estimate, there can be no doubt that the resulting levee was unusually tight and safe.

New Dredge Methods—Entirely different methods have been adopted on the Wilbanks & Pierce work already mentioned. The dredges are brought in upon the batture, either during high water or by temporary locks dug into the bank by a dragline. Side dikes are thrown up by a dragline, approximately along the lines of the base of the slopes, and the hydraulic dredges discharge between them. Spillways are constructed at suitable points and the water is returned to the borrowpit. Make-up water is supplied by a gasoline-engine pump outfit mounted on a barge with a flexible discharge line leading to the bank. The 12-in. dredge used on the Onward job was supplied satisfactorily by an 8-in. pump driven by a tractor engine operating only part time. Fig. 4 shows the method of operation in building the levee. From this it will be seen that a dragline is necessary for building the retaining dikes and for dressing off the levee after the material has been placed to approximate section by the hydraulic dredges. The dragline also is useful in digging the locking-in-pits and for filling them after the hydraulic dredge moves off the job.

For economical results, even with small dredging units, individual jobs should be of reasonable size, as the cost of moving to and from the job is considerable. It would be my opinion that the cost of moving, and more particularly the difficulty of control of large volumes of water between temporary earthen embankments, would limit the economical size of such dredges to 12-in. discharge, or at the most to 15-in. Even with the comparatively small units now in use, great difficulty is experienced in the construction of short sections of levee, because the period of retention of the discharge material is not great enough to permit the precipitation of any but the heaviest materials.

Small hydraulic dredges are open to the objection that their suction lines are more readily obstructed by roots and débris, but this can be overcome to a considerable degree by more careful grubbing in advance of the dredge.

Railway Haul—An unusual condition exists on the Ward-Hayes job at Cairo, which has been mentioned as being done by cars dumping from railway. This work consists of raising and widening about 5½ miles of levee with the only readily available material located at one end of the work. The Mobile & Ohio Railroad main-line

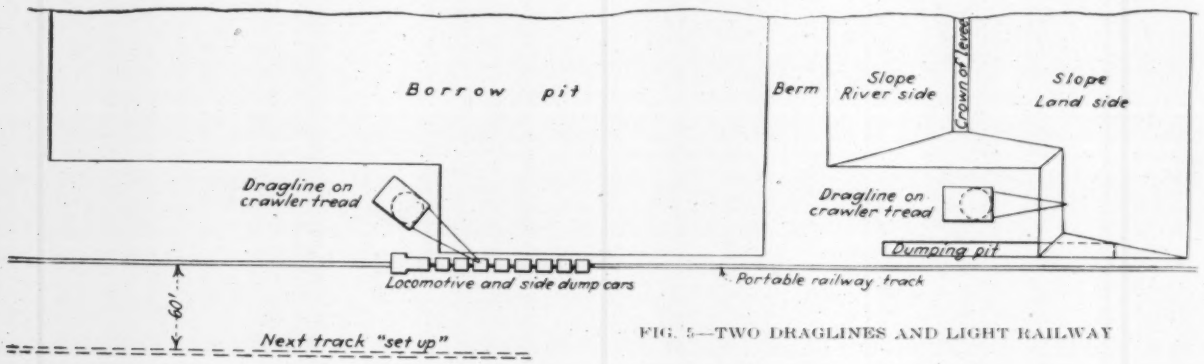


FIG. 5—TWO DRAGLINES AND LIGHT RAILWAY

track occupied the top of the old levee. By securing the co-operation of the railway the contractor developed a plan for widening the existing levee by dumping from the main line and using a Jordan spreader. In this way an 18-ft. shoulder was built out and on this new work a narrow-gage line was constructed from which raising and further widening were carried on. All cars were side-dump, those used on the main line being 12-yd. and the narrow-gage cars 5-yd.

A truly novel method has been devised by the Canal Construction Company to construct a levee by train haul at Lake Cormorant, Miss. The levee averages about 23 ft. in height with a borrowpit of conventional type as illustrated in Fig. 3. The plant layout is illustrated by Fig. 5. Side-dump cars are loaded by dragline travel to the levee on a narrow-gage track which runs transversely to the line of levee, and dump into a pit previously dug for the purpose. From this pit the material is handled by another dragline. It is claimed that a standard levee 30 ft. in height can be built by a dragline having a 60-ft. boom without rehandling the material. Track set-ups are made at intervals of 60 ft., a new track being laid while the other is in use. The track is also pulled ahead at times by a crawler tractor. The maximum train haul is 900 ft.

The limiting element in this method appears to be the loading equipment, though if this should delay other operations unduly it would appear to be possible to employ a double loading track and a second loading unit. The method offers many advantages, such as the use of rugged equipment which already has become well standardized, reasonable freedom from interference by adverse weather conditions and flexibility. If the operation of

the three major elements can be kept in proper synchronism so that each may work practically to capacity, the method should be well suited to its work. It should show results to best advantage as compared with other methods of construction where unusually wide berms and borrowpits are required. It apparently could not be used to advantage on light work such as levee enlargement jobs.

Levee Prices

With the increase in length of haul resulting from the larger levee sections and the rigid requirements governing borrowpits, it was quite generally expected that there

FIG. 6—LAKE CORMORANT JOB USING DUMP CARS AND DRAGLINES IN BORROWPIT AND DUMP PIT
Note the high-grade stakes. Levee building dragline at left secures greater rang by operating on a bench. Four complete units are engaged on this contract.

would be a decided advance in prices bid, but during the present season this has not been the case, bids being received at the initial letting which usually were below the limit set by the commission. On the "lower coast" (that portion below New Orleans) levee work has been let for as low as 14c., this being for the construction of levees about 12 ft. in height. Through the upper part of the New Orleans River district the prices have held very close to 18c. excepting where special conditions would make construction more difficult than ordinarily encountered. Farther up the river, where levee heights are greater and hauls are longer, prices average about 25c. per cubic yard, with an increase where special conditions exist. The Cairo job went for approximately 42c.

Various causes have contributed to these low prices, an important factor doubtless being the dearth of large earth-moving jobs in all sections of the country. Some have mentioned the large amount of idle equipment as being a principal cause, though this does not appear to me to have played a large part. The bulk of the equipment in use seems to have been purchased recently for the specific work on which it was engaged. Idle personnel and capital which ordinarily are engaged in contracting probably played a greater part than idle equipment. In addition to the experienced levee men a considerable number of new outfits have been attracted to the field by the prospect of long-continued work.

FIG. 7—SPREADER WIDENING LEVEE SHOULDER

Probably an important factor in holding down prices has been the recent tendency on the part of the commission engineers to "ease up" on specifications where this can be done without sacrifice to the results desired. Criticism has been expressed by some of the large contractors of the method of letting work in comparatively small units, 1,000,000 cu.yd. being considered as a big job. I seriously doubt, however, if letting out work during this season, or even during the next season, in lots of several million yards would result in a benefit either to the public or to contractors. The earlier jobs necessarily are scattered both as to location and to nature of work, and with the great program contemplated for the next several years individual jobs of reasonable size should form the best kind of a school for both contractor and engineer.

General Conclusions

With a reduction in cost of the long haul, which promises to follow the introduction of new equipment and methods, levee engineers not only should be able to build better levees on better locations at a reasonable cost but they should be able, where suitable materials are encountered, to select that which is the more suitable. For most engineering works of importance the site is selected with great care and far distant points are drawn on for materials best suited to the service required. Important levee systems are about the only such work in which the engineer has been compelled to use the material immediately at hand.

The experience gained during the present and the coming year should enable contractors and engineers to determine the best types of construction equipment and the best methods of operation to be employed in the river-control works and also should result in the elimination of those found unsuited. This determination is of interest to the engineers as well as to the contractors, for on the success of methods employed will depend the cost and even the design of the works.

Landslides and Earthquakes

A warning that earthquake movements may have special effects in regions containing deep sliding clays and known to be subject to landslips is given by Prof. E. A. Hodgson, seismologist of the Dominion Observatory at Ottawa, in a recent paper, "The Marine Clays of Eastern Canada and Their Relation to Earthquake Hazards." This paper describes the noteworthy series of landslides in the St. Lawrence River tributary valleys which were reviewed in *Engineering News* of May 27, 1909, p. 576. It also records a later slide in the same general region, which occurred in the fall of 1924, at a point about 2 miles west of Shawinigan Falls, just off the St. Maurice River, and makes reference to another, in the fall of 1925, near Portneuf station. The author then states: "These slides are made possible by the intermixture of permeable material with the clay . . . They complicate the hazard problem if the regions in which they exist are seismic. A comparatively slight shock may well serve to set off a slide if the conditions of ground moisture and clay structure co-operate . . . If no stratum of porous material is found, no apprehension need as a rule be entertained. If such a stratum exists, every care should be taken to find out its slope, its extent and its possible connections with sources of water, and no opportunity should be neglected to prevent surface water from reaching it."

Concrete Problems Discussed at Detroit

American Concrete Institute Program Covers Timely Questions of Ready-Mixed Concrete, Truck Haulage and High-Early-Strength Concrete—Survey of Condition of Structure in Service—Concrete in Sea Water

A MUCH more definite regard for the timely problems confronting the concrete specialist than has been apparent at previous meetings and a commendable attitude of questioning applied to all present-day concrete work characterized the 25th annual meeting of the American Concrete Institute in Detroit last week. Outstanding on the program were two groups of papers, one of which comprised a condition survey of existing structures and the other a symposium of ideas on standards of performance for concrete under various conditions and for various uses. Among the important subjects considered by individual papers on the program were high-early-strength concrete, retempering, strength tests of mixes containing aggregate too large for standard cylinders, ready-mixed concrete, shrinkage and designing for continuity.

In total, discussion was not as great as could be desired, a condition largely attributable to the regrettable absence of an unusually large number of the authors of the papers. About 600 members and guests were registered and attendance at each of the seven sessions, including two evening meetings, was excellent.

Monthly Journal to Replace "Transactions"

Edward D. Boyer was elected by acclamation to succeed himself as president. In his inaugural address he made an urgent plea for the more general use of commercial or field research, as distinguished from our present laboratory studies, and an equally urgent plea for resistance against efforts of standardization which throttle initiative. In conclusion he announced a radical change in Institute practice—the abolishment of the annual *Proceedings* and the substitution therefor of a monthly journal to be published from September to June inclusive each year. It is hoped that the new plan will considerably increase the annual output of papers. Presumably all differences and doubts as to the practicability and economy of the plan had been previously dispelled, for no objections were made to it in the meeting. It is planned to begin publication of the *American Concrete Institute Journal* during the current year.

In addition to the re-election of Mr. Boyer, the following officers were elected: vice-president, S. C. Hollister; secretary-treasurer, Harvey Whipple; new directors, J. C. Pearson, P. H. Bates and A. R. Lord. A committee was appointed to draw up a resolution of appreciation for the years of service given to the Institute by the late Richard L. Humphrey, past-president.

Medals for McMillan, Hollister and Hatt

Recognition for outstanding work in the profession was accorded three members by the presentation of medals. F. R. McMillan for his "Concrete Primer" received the Leonard C. Wason medal for "the most meritorious paper" at the 1928 convention. The Leonard C. Wason research medal was awarded to S. C. Hollister for advancing the art of bridge construction, exemplified by his paper on "Design and Construction of a Skew Arch" presented at the 1928 meeting. The Henry C. Turner medal "for pioneer work in reinforced-concrete research; for a quarter century of devoted, outstanding and continuous service in developing the knowledge of concrete" was awarded to Prof. William K. Hatt, of Purdue University.

Long-Time Service Experience

It is not possible or practicable to review the extensive technical program here, but some of its major features are summarized.

Active study of past concrete-making practice and the condition of old concrete structures has been begun by the Institute through a special committee headed by F. R. McMillan. Three valuable papers resulted from the year's work of this committee: a report on construction methods and present condition of nine dams forming Thomson reservoir in northern Minnesota, built 1905-07; a review of concreting practice on the Erie Railroad during 30 years; and a classification and analysis of six prominent types of defects in concrete structures caused by incorrect methods of mixing, placing or finishing.

The Thomson dams show unusually excellent condition for the most part but some localized defects. M. B. Lagaard, of the Portland Cement Association's research laboratory, reported on the condition and explained the cause of the defects. The latter appeared mainly in sections built of very dry concrete tamped into place, as practiced prior to 1900; little or no bond between successive layers resulted. H. C. Ash, resident engineer on the reservoir during its construction, described the methods used, which included careful experimental development of mixture proportions to give a dense concrete, four-minute mixing, and "thick mush" consistency. On one section the mix was so dry as to require heavy ramming, but with this exception "dry concrete requiring much tamping, and free water on the surface of placed concrete, were both discouraged with emphasis." The latter practice was followed in the best-preserved sections, but even the rammed section is described as "sound, and good for several decades longer."

L. W. Walter, inspecting engineer of the Erie Railroad, described the practice of the successive periods of dry tamping, moderately wet consistency, the fluid consistency that became common with the widespread use of chuting (beginning about fifteen years ago), the abandonment of overwet mixes and return to plastic consistency, coupled with limitation of chute angles and related details of practice. He showed a number of examples of disintegration, mainly built in the period of fluid mixes.

Under the title "Lessons From Concrete Structures in Service," R. B. Young, testing engineer of the Hydro Electric Power Commission of Ontario, presented an analysis of concrete defects that were traced to six causes: (1) Water gain during the placing of a single lift, resulting in excessive fines or laitance at the top and leading to undercutting; (2) non-plastic and therefore open-textured concrete at the bottom of a lift, resulting in leakage and disintegration above the joint; (3) segregation due to letting the concrete flow or roll along in the forms; (4) overmanipulation by either excessive spading or steel troweling; (5) segregation due to trap-

ping of aggregate along inclined top forms; and (6) freezing before sufficient curing has been obtained.

In a brief discussion some useful auxiliary views were brought out. P. J. Freeman, of the Public Works Department of Allegheny County (Pa.), after asserting that three-fourths of our concrete troubles should never have happened, brought out the injurious effects of using unsound limestone in some paving and wall construction. A. S. Douglass, of the Detroit Edison Company, told of good results through compacting the concrete in the forms by using an air hammer with a flat rammer head on the posts of the forms, but stated that one must learn how not to use the hammer too much. Others recalled the successful use of air-hammer vibrating on the war-time concrete ships and on concrete of the Delaware River bridge and the Arthur Kill bridges.

K. Friis, of the Concrete Committee of Norway, reported that a condition survey of concrete dams in Norway was begun three years ago, as a result of observed deterioration. It was found that leakage is increasing, never stanching itself as it does in some other countries, probably because of the acid character of Norwegian waters.

Concreting Practice and Control

Two related papers described concreting practice and control methods of the Detroit Edison Company (A. S. Douglass and J. S. Nelles) and of the Detroit Water Board (L. G. Lenhardt). The latter dealt with concrete lining for water tunnels. Among the practices followed is the use of rubber-faced air hammers for vibrating the forms (except at the crown, where ramming from the open end is the only compacting method available). The slump used ranged from 5 to 6 in. at the invert to 2 in. at the crown; nevertheless the strength of cores taken from the lining decreased from invert to crown.

Concrete control in building operations was reviewed by the Detroit building inspector, John M. Bischoff. Under regular test-cylinder control the strengths found show an increase from year to year.

Standards of Performance for Concrete

A group of nine papers discussing the necessary characteristics of concrete for various types of structures and conditions of use and exposure brought out timely and useful information. That concrete can be made sufficiently durable to resist sea water exposure was emphasized strongly in a paper by H. E. Squire, assistant harbor engineer of San Francisco. It must, however, be recognized that concrete has certain limitations in protecting reinforcing steel and it must be admitted that periodic maintenance and occasional repairs are necessary; it is foolhardy to take concrete's claim of permanence too literally. This fact was brought out strongly in discussion by P. H. Bates and others, who pointed to the detrimental psychological effect of claiming absolute permanence for concrete. Relative permanence is more nearly correct, and it was suggested that clauses be inserted in specifications stressing the fact and the corollary that maintenance by painting or otherwise is necessary and to be expected.

Significant findings in the search for a solution to the problem of making concrete resistant to alkali groundwaters were reported in a paper by Dean C. J. MacKenzie, of the University of Saskatchewan, based largely on the investigations of T. Thorwaldson, working under the auspices of the Engineering Institute of Canada, and of D. G. Miller, working with the U. S. Department of Agriculture and the University of Minnesota. These findings are listed as follows:

1. The actions of sodium sulphate and magnesium sulphate, which formerly were supposed to be similar, differ materially and affect different cements in different ways.
2. Concretes and mortars made from portland cements from different mills and from different raw materials may differ widely in their stability in alkali waters.
3. Strength tests are not indicative of the relative sulphate resistances of different cements. However, when using any given cement, the concentrates giving the greatest strengths are the most resistant for mixes up to about 1:2. Neat cement blocks, on the other hand, disintegrate in a very unusual and violent manner.
4. Some high-alumina cements are very resistant to attack by magnesium sulphate and are more resistant to sodium sulphate than most portlands; on the other hand, they are quite easily attacked by sodium carbonate or so-called "black alkali."
5. Even a lean concrete made from a cement of low natural resistance to alkali can be steam treated at a temperature of 212 deg. F. or more and made absolutely immune to attack by sodium sulphate and resistant to attack by magnesium sulphate.

For concrete for pavements F. H. Jackson, senior engineer of tests, U. S. Bureau of Public Roads, recommended more attention to flexural and tensile resistance than to crushing strength. In discussion it was pointed out that more attention to sub-base construction would increase the importance of crushing strength for concrete in pavements. Mr. Jackson listed the following principles for producing good pavement concrete:

1. Adoption of proportioning by weight, with inundation recognized as a permissible alternative method for fine aggregate.
2. Use of lowest possible water-cement ratio.
3. Grading of coarse aggregate by combination of separate sizes in proportions which will produce the maximum practical density.
4. Abandonment of hand-finishing methods.

A paper on "Wear Tests on Industrial Concrete Floors," read by John G. Ahlers, of the Barney-Ahlers Construction Corporation, New York City, described a series of tests made on nine types of industrial cement floor finishes to show comparative wearing strength. The finishes were all fairly expensive and there is need for additional tests on cheaper types of finish.

"Standards of Performance of Concrete for Stucco," by W. D. M. Allan, manager, Cement Products Bureau, Portland Cement Association, stressed the fact that most of the known data regarding concrete in general are applicable to stucco. A paper on "Concrete Masonry Units" by E. Grant Lantz, also of the Cement Products Bureau, Portland Cement Association, emphasized those properties other than strength which are important—namely, temperature insulation, fire resistance, sound insulation, weight, wall efficiency, bond and permanence.

Construction necessary to secure livability in concrete dwellings were listed in a paper on the subject by S. C. Hollister, consulting engineer, Philadelphia, as (1) prevention of moisture rising from the foundations by sealing the top of the foundation wall at a level not less than a foot above ground level with a bituminous compound; and (2) prevention of moisture absorption through the walls and from the walls into the floors and roof slabs; porosity is a desirable characteristic, for it prevents capillarity and gives good mechanical bond for stucco.

In a paper on "Reinforced-Concrete Buildings," by N. L. Doe, general superintendent, Turner Construction

Company, New York City, uniformity was stressed as the outstanding requirement for the concrete. Other "standards of performance" are the systematic use of field cylinder tests, the use of methods producing better finishes on walls, beams and columns, the adoption of strength specifications and attention to economy through construction plant layout and scientific mixing and proportioning. The last paper in this symposium on "Concrete for Fire Resistance," by N. D. Mitchell, U. S. Bureau of Standards, was read by title only, since the author was not present.

High-Early-Strength Concrete

The various factors which affect the rate of hardening of concrete and therefore the rate of gain of strength, such as kind of cement, water-cement ratio, temperature, admixtures, curing and time of mixing, were discussed quite fully in a paper on "High-Early-Strength Concrete," by Edward E. Bauer, instructor in civil engineering, University of Illinois. Both standard portlands and special portlands which are often designated as high-early-strength cements were considered. With regard to the special cements the author believed that the manufacturers' recommendations should be followed, at least for the present. He pointed out that time-strength curves for these various special cements are quite different, making it impossible to secure average curves for this type. The special cements sell for $1 to $1.50 more per barrel than do the standard brands. Translated into terms of pavement, for a slab 7 in. thick the extra cost for cement would be between 30 and 45c. per square yard. Other findings reported in the paper were as follows:

1. Concretes with low water-cement ratios develop the higher strengths whether standard portland or special cements are used.
2. At temperatures above freezing and below approximately 150 deg. F., higher strengths are developed for the higher temperatures. Concrete which is frozen does not gain any strength.
3. The influence of calcium chloride is largely a matter of curing. Thus the Bureau of Public Roads tests indicate that at 28 days the strength of the concrete cured with calcium chloride in the mixing water is as great as when cured with water in the usual way. Different cements react differently with calcium chloride and the amount to be used is thus a factor to be determined for each cement.
4. Moist curing has a beneficial effect on the early strength of concrete and should not be omitted.
5. Increasing the time of mixing is generally assumed to increase the early strength of the concrete more than its later strength.

Information on Central Mixing Practice

Two of the most important papers at the convention considered some of the problems of centrally mixed concrete which are daily assuming greater importance. A paper, "Tests of Retempered Concrete," by H. F. Gonnerman, manager, research laboratory, Portland Cement Association, and P. M. Woodworth, also of the laboratory, gave the results of studies carried out for the purpose of determining the effect on the workability and the strength: (1) retempering with and without the addition of water, and (2) premixing the cement and water for extended periods prior to mixing with the aggregate. The tests, which are the most comprehensive yet undertaken, covered more than 9,000 cylinders made from December, 1926, to March, 1927, using a blended portland cement of normal chemical composition and physical characteristics. The conclusions from the tests are as follows:

1. The most striking result was the small loss in compressive strength due to standing for periods up to six hours (protected from evaporation) for concrete remixed without the addition of water. When the mixtures remained plastic and workable, the loss was practically nil, but after the concrete ceased to be plastic the strength fell off rapidly.
2. In concrete remixed with the addition of water to restore original flow after standing for periods up to six hours (protected from evaporation) the strength was reduced in accordance with the increase in the water-cement ratio resulting from the added water.
3. When standing unprotected so that water was lost through evaporation an increase in strength resulted due to the lowered water-cement ratio.
4. Wetting the aggregates sixteen hours in advance of mixing the concrete gave about the same strength of concrete as was obtained with dry aggregates using the same total quantity of mixing water.
5. Premixing the cement and water for one minute and allowing the paste to stand for periods up to six hours before adding the aggregates resulted in a gradual reduction in the compressive strength as the standing period increased, which reduction at the six-hour period amounted to about 20 per cent of the strength at the zero-hour period.
6. Increasing the time of mixing from 1.2 to 10 minutes resulted in an increase in compressive strength both for concrete mixed in the usual manner and for concrete made by premixing the cement and water before adding the aggregate.
7. Tests of a 1:4½ concrete mixture containing 15 and 25 per cent of hydrated lime or Celite by volume of cement, when remixed with and without the addition of water after standing for various periods, showed results similar to those obtained with concrete of the same mix without admixture.

In discussion, Duff A. Abrams expressed the opinion that we must discard the idea that concrete held from 30 minutes to one hour is not suitable for use.

The second paper on this general subject was titled "Purchasing Centrally Mixed Concrete," by P. J. Freeman, engineer of tests, Allegheny County (Pittsburgh, Pa.). In it Mr. Freeman cited his experiences in using purchased concrete for bridges, retaining walls, pavements and miscellaneous structures. No lowering of strength on account of haulage has been discovered. There has been no retrogression in quality so long as segregation is absent. In discussion W. E. Hart, of the Portland Cement Association, called attention to the advisability of an Institute specification covering centrally mixed concrete.

Research and Design

A very important paper titled "Volumetric Changes in Portland Cement Mortars and Concretes," by R. E. Davis, professor of civil engineering, and O. G. Troxell, assistant professor of civil engineering, University of California, was read by title only, since neither of the authors was present. Briefly, the paper reports current results on long-time tests of concrete under controlled conditions of temperature and humidity designed to determine the effect on volume changes of variations in such factors as richness of mix, gradation of aggregate, quantity of mixing water, character of aggregate and conditions of curing. An outstanding result is that while shrinkage is rapid at first, later the rate of shrinkage becomes unimportant. In some cases a recovery or expansion is noted after the initial shrinkage. The tests give data not only on concrete and mortar specimens but on mortar in brick piers.

Another important paper which did not receive the attention and discussion it deserved was titled "Concrete Studies at the Bull Run Dam, City of Portland, Oregon," by T. C. Powers, of the Portland Bureau of Water. The

paper considered the problem of testing the strength of concrete containing aggregate too large for the standard test specimen.

In a paper, "Comparison of Methods of Determining Moisture in Sands," by William R. Johnson, assistant engineer, research laboratory, Portland Cement Association, it was reported that a series of tests had shown that drying to constant weight by denatured alcohol was, from the standpoint of simplicity, accuracy and speed, the best of six methods tried. The use of the A.S.T.M. flask was found to be inaccurate because of the scum which collected in the neck and obscured the scale. In discussion, Cloyd M. Chapman warned that several burnings by denatured alcohol each followed by weighing should be the procedure to assure that all and not only surface moisture is removed. He doubted that scum on the A.S.T.M. flask is cause of inaccuracy; it was probably froth and not scum and the water level could have been found below it. Mr. Chapman believes the A.S.T.M. method is much better.

In connection with a paper on "A Scientific Trial Method for Designing Concrete Mixtures," by Prof. R. E. Robb, of Evansville (Ind.) College, a new apparatus for determining the percentage of moisture in the aggregate was presented. Its design is based on the principle of water displacement and specific gravity of the aggregate, and the amount of moisture is determined directly by scales in various units on a Monel metal case surrounding the glass container. The apparatus must of course be calibrated for the particular aggregate to be tested.

Prof. Herbert J. Gilkey, of the University of Colorado, contributed a useful paper titled "Water Tables and Curves for Use in Designing and Estimating Concrete Mixtures." In this paper the various theories pertaining to water and cement as used in the current designing of concrete mixtures are correlated by means of convenient tables and figures.

A highly original method for allowing for continuity in reinforced-concrete design was presented by Hardy Cross, professor of structural engineering, University of Illinois. Briefly, the method, which is approximate, involves the treatment of each beam as fixed at its ends; and the calculation of the moments using the coefficient $\frac{1}{12}$. Since these will not be balanced at the joint, the unbalanced moment is distributed among the connecting members approximately in proportion to the ratio of moment of inertia to span length; about half of the unbalanced moment is carried over to the next joint and distributed as before. The method applies only to beams. It does not apply to columns, and, in Professor Cross' opinion, there is good reason to doubt that column moments can be determined with accuracy. The effect of haunches is largely to increase fixed end moments and if these moments are corrected for haunching it can otherwise be neglected in the method. Computations for maximum end shear seem worth making, but not with great precision. The important thing to recognize is that continuity in reinforced-concrete structures is a fact and not a theory and should therefore be considered by some logical method in the design.

A research paper entitled "The Mechanism of Corrosion of Portland Cement Concrete, With Special Reference to the Rôle of Crystal Pressure," by F. O. Anderegg, of Mellon Institute, outlined an accelerated method of determining the resistance of concrete to crystal pressure.

Specifications—L. E. Williams, engineer and director, State Concrete Materials Company, Detroit, reviewed the chaotic condition of aggregate specifications in the vicinity of Detroit, a condition believed to be rather general throughout the country. The author concluded that concrete of all classes should not require more than two specifications for fine aggregates; one written as broadly as is consistent with the requirements for the ordinary run of concrete; and one with possibly closer limits for work where either particular surface finish or exceptional workability are required. Coarse aggregates of three types or at the most four should fill all requirements. One should cover mass work, paving, etc.; a second ordinary reinforced construction, a third fireproofing with very close reinforcement, and possibly a fourth for work of a very special character.

A paper titled "The Development of Specifications for Reinforced Concrete," by George J. Eyrick, Jr., of Smith, Hinchman & Grylls, architects, Detroit, outlined the improvement in concrete quality by adoption of modern specifications which include requirements for grading both fine and coarse aggregate, the stipulation of the amount of water to be used per sack, the requirement of inundation of the sand and the establishment of a field testing laboratory for concrete control.

A paper on "Specifications for the Small Job," by S. C. Hollister, was reported by title only.

A purchase specification for concrete aggregates revised to accord with the A.S.T.M. specifications was reported by committee and adopted as a tentative standard. Test limits are based primarily on strength considerations.

Three other specifications reported by committee were adopted as tentative standards, a specification for cast stone, a specification for finish coat portland cement stucco, and a specification for reinforced-concrete culvert pipe. A revised specification for concrete brick was moved up to standard from a tentative standard.

Papers on artificial stone included the following: "The Development and Use of Commercial Cast Stone," by L. A. Falco, president, Decorative Stone Company, New Haven, Conn.; "The Physical Properties of Commercial Cast Stone," by John Tucker, Jr., and G. W. Walker, U. S. Bureau of Standards; "Testing Concrete for Absorption," by Fred Weigel, Southern Cement Products Company, Knoxville, Tenn.; "The Limitation of the Absorption Test for Concrete Products," by Raymond Wilson, associate chemist, Portland Cement Association; and "The Effect of Curing Temperatures," by R. A. Foley, Superior Products Company, Detroit. The committee on concrete products plant operation reported on the "Effect of Time of Mix on Non-Plastic Concrete."

A Daring Concrete Arch Bridge Project

A. R. Lord made a most interesting presentation of a paper, "Long Span Arch Bridge in France," by M. Freyssinet, the designer and constructor. The paper had been translated by S. C. Hollister. It consists of three arches of 612 ft. across the harbor at Brest, France, probably the longest concrete arches yet constructed. Each arch has a rise of 110 ft. and a box cross-section consisting of an upper and a lower barrel with turn walls at each side. Both a railway and a highway deck are provided. No obstruction from falsework was permitted and the arch centering was built on land and floated to the site. The many unusual design and construction expedients on this structure will be considered in a separate abstract to be published later.

Possibilities for Reinforced Brickwork

With a Survey of Practice and Tests in India, Where Such Construction Has Been Used for Floors, Roofs, Stairways, Bridge Decks, Lintels and Cornices

By L. B. Lent

Engineer, Common Brick Manufacturers' Association, Cleveland, Ohio

REINFORCED brickwork appears to have much larger possibilities than have yet been realized in American practice. It consists of brick masonry built with reinforcing steel laid in the mortar joints to take the tensile stresses, so that the completed structure performs much as does reinforced concrete. Indeed, it has been found that the design formulas for reinforced concrete are equally applicable to reinforced brickwork. Slabs, beams and other structural parts have been built of reinforced brickwork, and laboratory research has contributed enough essential information that we can now design this type of construction with a high degree of confidence, reposing equal confidence in its performance and permanence.

Reinforced brickwork has been used more extensively in India than in any other country. A complete report of its use there is found in Technical Paper No. 38 of the Government of India Public Works Department. Some of the favorable characteristics of reinforced brickwork mentioned in the report are as follows: (1) Simple construction; (2) sound and permanent work involving low repair charges; (3) high fire resistance; (4) high thermal resistance; (5) pleasing appearance of the finished work, which requires no other finish; (6) ability to obtain good construction with ordinary labor and with minimum supervision; (7) ability to cut holes of fair size in the work after it has set, without detriment to the structure; (8) pleasing appearance of the underside of jack arches and "T" and tile floors and roofs; (9) immunity from damage by earthquake.

What follows is taken largely from this Indian government report and from the report of an investigation made at the University of Missouri by Mason Vaugh, who had several years' experience in India on this type of work.

Practice in India—In India reinforced brickwork has been used extensively in floors, roofs, staircases, overhanging cornices, bridge-decking and even hanging partitions, in addition to the more common window and door lintels which have seen limited use in this country.

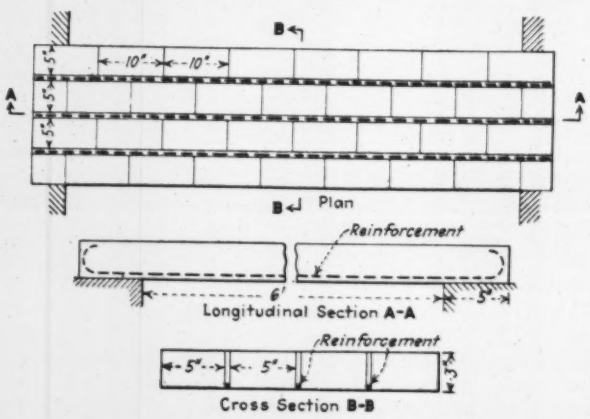


FIG. 1—TYPICAL REINFORCED BRICKWORK SLAB

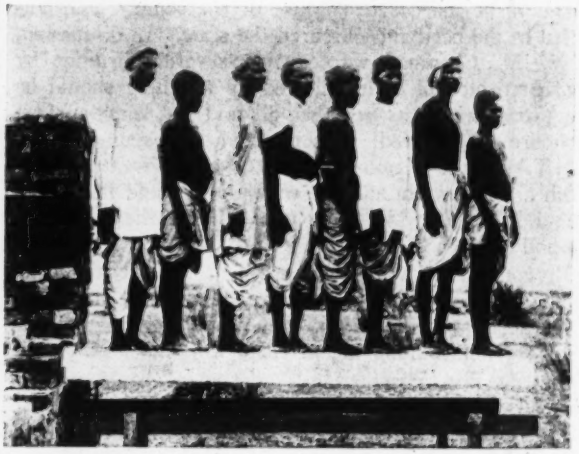


FIG. 2—A REINFORCED BRICKWORK CANTILEVER BEAM

The position of the reinforcing rods in a simple slab reinforced in one direction only is shown in Fig. 1. Each rod is placed in the joint as the bricks are laid in horizontal courses and is incased in the mortar as near as practicable to the lower surface, so that the steel takes the tension stresses and the brick and mortar the compressive stresses. Tests given in the report on reinforced brickwork slabs describe failure as a gradual sinking down of the slab only after the yield point of the steel has been passed.

With regard to the safety of reinforced brickwork the Indian report states: "At first sight it would seem that brickwork could not be a homogeneous mass in the sense that concrete is and that the joints in the work would present planes of weakness along which failure would readily take place. In practice it has been found that this is not so. On the contrary, it has been proved that this factor is so insignificant that it can be neglected. There is no reason why reinforced-brick structures should not be as successful as reinforced-concrete ones of a similar nature provided ordinary precautions are taken in designing and carrying out the work." Further experiments in this country fully confirm these statements.

Some Examples—In the following examples taken from the Indian government publication, most of the dimensions noted are determined by the size of Indian bricks, which are approximately 3x5x10 in. as compared with the standard size in this country of $2\frac{1}{4}$x$3\frac{3}{4}$x8 in. In applying Indian practice to practice in this country, this difference in brick dimensions should be kept in mind, inasmuch as brick sizes fix slab and beam dimensions within certain limits. Otherwise the results obtained in India might well be duplicated here, for our bricks are uniformly stronger than those made in India and the strengths of mortar joints and of steel are at least equal. For instance, the compressive strength of Indian brick averages less than 1,500 lb. per sq.in., the best bricks rarely going over 2,000 lb., while in this country mini-

mum compressive strengths average about 3,000 lb. per sq.in. and maximum strengths are over 20,000 lb. per sq.in. Incidentally, the subject of brick strength is of minor importance, since, as previously noted, it has been found that the tensile strength of the steel reinforcement and not the compressive strength of brick and mortar measures the ultimate strength of well-designed reinforced brickwork construction.

The accompanying illustrations show the more common designs of reinforced brickwork which have been used in India. Among the types of construction in reinforced brickwork on which satisfactory test results have been recorded, the following may be cited: (1) Roof and floor slabs of all kinds supported on two sides, generally reinforced in one direction only and with or without covering such as concrete; (2) roof and floor slabs supported on four sides, generally reniforced in both directions; (3) lintels over doors, windows, etc.; (4) beams; (5) T-beams and long span beams suitable for bridge girders; (6) beams reinforced with rolled steel joists; (7) hanging partition walls with and without door or window openings; (8) slabs capable of being used over culverts or as decking of road bridges; (9) columns; and (10) arches.

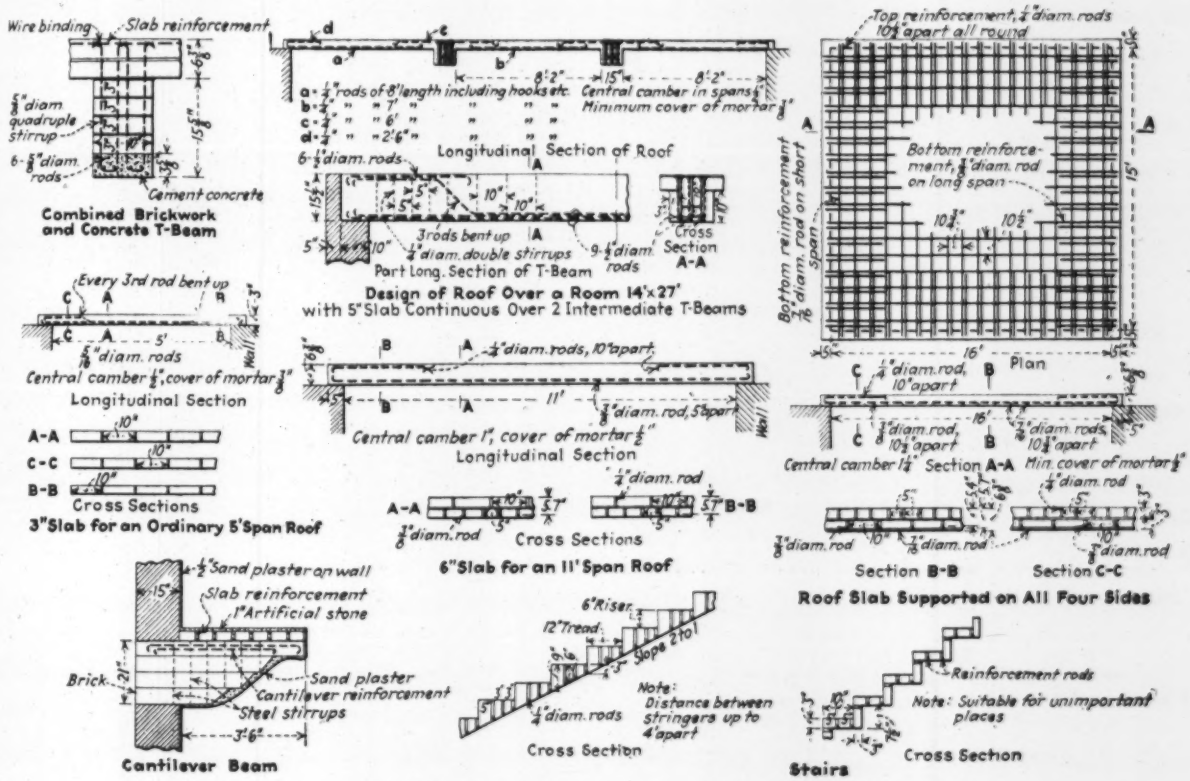


FIG. 3—DETAILS OF REINFORCED BRICKWORK BUILT IN INDIA

These tests have shown, according to the Indian government report, that 3-in. slabs may be used for floors or roofs on spans up to 5 ft. with safe loads from 40 to 50 lb. per sq.ft. Also, as a cheap and useful ceiling such slabs may be used in spans up to 8 ft.

Missouri Tests—The results of Vaugh's experiments at the University of Missouri last year indicate that slabs of brick laid flat, 2¼ in. thick, with ¼-in. rods in each longitudinal joint (4½ in. between centers), are safe for a load of 25 to 30 lb. per sq.ft. on spans up to 8 ft. with a factor of safety of 3. His experiments on slabs of brick laid on edge, 3¾ in. thick, with ¼-in. rods in each joint (2½ in. between centers), show that, with a safety factor of 3, such slabs are safe for loads of 30 lb. per sq.ft. on spans up to 14 ft. and 60 lb. per sq.ft. on spans up to 10 ft. Deeper slabs can of course be built by making them thicker than one course of brick. It has been found that the increased moment of inertia thus obtained adds the same strength as in reinforced concrete, provided the steel reinforcement is sufficient to care for the tensile stresses developed.

Both solid and hollow brick beams have been built and tested. Beams of brick in combination with hollow tile and with concrete have also been extensively studied. In practically every test the failure occurred by straining the reinforcing steel in tension or by fracturing the masonry in diagonal shear. It was found that metal stirrups were necessary in the deeper beams of longer spans to take the diagonal shear stresses.

The test results have shown that the following design assumptions may be considered safe: Tensile strength of steel, 16,000 lb. per sq.in.; working stress of brick in compression, 700 lb. per sq.in., in shear, 60 lb. per sq.in.; adhesion between steel and mortar, 90 lb. per sq.in.; and a ratio of 15 between moduli of elasticity.

Construction Considerations—Experience in India during the past fifteen years has shown that the main requisites for constructing good reinforced brickwork are adequate centering, good materials and careful work.

As in reinforced-concrete work, some form of centering is required on which the work can be constructed and supported until such time as the mortar has set, but it will usually be of much simpler kind. The length of time that the centering should remain in place depends on such conditions as the character of the mortar, the season of the year, atmospheric conditions and the span

of the beam or slab. In some cases centering may be removed as soon as four days after construction and in others as late as 28 days. Usually it can be removed in less than a week.

As previously pointed out, the bricks may be of rather low compressive strength, inasmuch as tests have shown that failure usually occurs in the steel reinforcement. A certain amount of porosity and absorption of the brick tends to promote a better bond between brick and mortar and mortar and steel. Either cement or cement-lime mortar should be used; the addition of a small amount of lime to a straight cement mortar increases its workability and helps to increase adhesion.

Careful workmanship in constructing reinforced brickwork is of course as important as in any other type of construction. The simplest and cheapest way to obtain a smooth surface is to spread about 1 in. of earth over the rough planking of the form. After this is beaten flat or to the necessary camber and finished with a thin sprinkling of fine sand, the bricks can be quickly and truly laid. Other points of workmanship may be summarized as follows: Bricks should be thoroughly wet before using except in freezing weather; reinforcement should be properly arranged; all joints should be well filled with mortar and the reinforcement completely surrounded by mortar; as far as possible each unit of construction should be finished in one operation, although this is not absolutely necessary; and centering should be carefully removed in order to avoid shock to the masonry.

Although it was found in India that the cost of reinforced brickwork construction was considerably less than that of reinforced concrete, it does not necessarily follow that such would be the case in this country. Such work as has been done in the laboratories here indicates that certain forms of construction can be done as cheaply in reinforced brickwork as in reinforced concrete, especially in those cases where a surface finish is required on the concrete. Thus reinforced brickwork might be particularly applicable to steel-frame buildings where it could be carried around the structural steel framing members to form a pleasing exterior finish without further treatment.

Reinforced brickwork has not been adopted in this country on any considerable scale, although it has been successfully used for such details as window lintels and walls requiring high lateral strength. However, it appeals to the writer as possessing many worth-while qualities and being worthy of many practical applications.

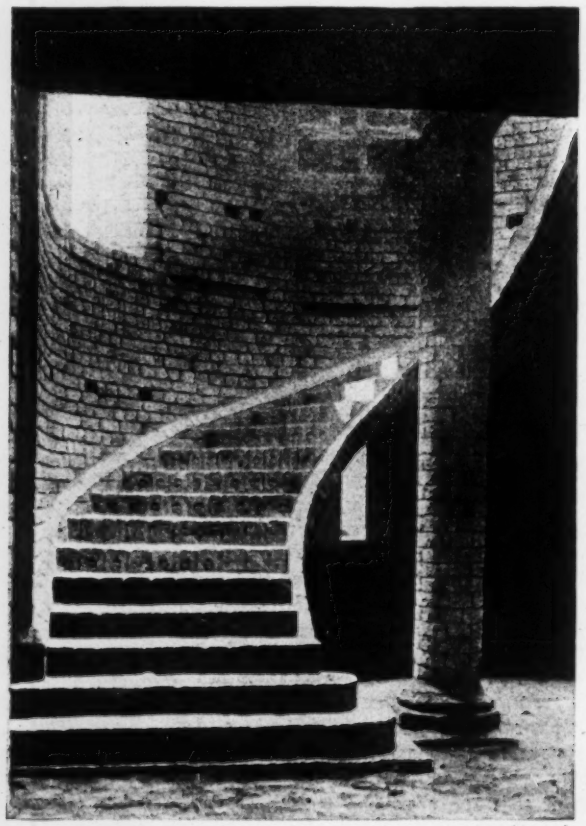


FIG. 4—SPIRAL STAIRCASE IN REINFORCED BRICKWORK

Disposal of Waste Crank-Case Oil at Garages

Practice in American and Foreign Cities With Recommendations for Commercial Recovery in District of Columbia

A PLAN for the protection of sewers from dangers incident to the discharge into them of crank-case oils in garages, a plan which at the same time would pay for itself by recovery of the oil and save garage trouble and expense, has been devised as a result of a survey made by engineers in the employ of the District of Columbia. Its recommendations for district plumbing regulation to put the plan in effect, so far as official regulations go, together with suggestions for handling the commercial end of the plan, are before the district officials.

The survey was made at the direction of J. B. Gordon, sanitary engineer for the district, and was conducted by Brunor E. Lundy, of the district sewer department, under the supervision of Hermon Garner, assistant engineer. A report on the survey has been made in mimeographed form, by Mr. Lundy. It contains a short tabular summary (here reproduced) of the results of a questionnaire which brought replies from 46 American cities, together with abstracts from reports received in answer to an inquiry sent to both American and foreign cities, some of which, condensed, are given farther on.

Conclusions of the Report

Some conclusions of the report, including the recommendations for changes in the zoning regulations of the District of Columbia, follow:

With all the information as cited herein at hand, including the reports from the U. S. Bureau of Standards showing the value of the product, the plumbing regulations of the District of Columbia were recommended to be revised in this respect and amended to require the maintenance by garages, filling and service stations, automobile repair shops, etc., of approved containers or underground tanks, separate and apart from garage traps, for the retention of all waste crank-case oils, the contents of the same to be removed by the occupant or operator at regular intervals or upon notice from the district authorities. Regulations for the safe transportation of this commodity are also included in the proposed amendments.

The adoption of these regulations will necessarily require provision to be made for the safe and systematic disposition of the waste oil so retained. The dumping grounds in the district and vicinity have prohibited the receiving of such refuse (waste oils or contents of garage traps), and in order

that the public may be fully protected in the matter of disposition of these accumulations of waste oil retained under such regulations, particularly as to the more or less isolated sections being properly provided with disposal service, a proposal is being submitted for approval whereby a contract may be made under competitive bidding for the collection, transportation and disposition of such waste oil as may become available. Such services as may be contracted for will be guaranteed by proper bond, regulated by direct supervision of the district government as to scope of service, maintenance of facilities for collection, transportation and disposition and all other conditions which will make for a thorough and systematic service.

In view of the fact that the re-refined product has been determined usable and valuable, it is expected that this contract service will be without cost to either the district or the public, the contractor realizing his earnings from the ownership of the available oils so collected. No monopoly is to be granted the contractor except that requests made by the public on the district for the removal of oil will become an order on the contractor for the rendering of this service.

PRACTICE IN 46 CITIES OF THE UNITED STATES AS REGARDS DISPOSAL OF CRANK-CASE OIL IN GARAGES

	Per Cent
Prohibiting disposal of waste oil in sewers	70
Not prohibiting	25
No definite reply	5
Cities collect waste crank-case oil	7
Commercial firms collect to some extent	55
Intercepting garage traps required	75
Fires or explosions in sewers	35
Trouble from presence of oil in sewers	65
Interest in subject shown	85

In this way the outlying sections of the district will be supplied with disposal service on a par with the more densely populated part of the city. The occupant or operator of any premises may dispose of the oil so retained in any manner he may choose, the only stipulation being that its disposition must be in accordance with the regulations.

Under these conditions it is estimated that more than 200,000 gal. of waste oil should be available for collection annually. It is believed that the public will be quick to realize the importance attaching to the exclusion of this waste from the public sewers as well as appreciate the advantage to be gained from its free and regular removal, especially the latter, as it costs the operator some 2 to 3c. per gallon to have it removed when deposited with silt in garage intercepting traps. A decided improvement of the condition of the interior of public sewers may confidently be expected to result from the adoption of these measures, the danger from fires and explosions in sewers minimized, thousands of gallons of oil which has heretofore been a source of danger and expense conserved for re-use and a commercial enterprise of appreciable moment encouraged and developed.

Disposal in Other Cities

Methods of disposing of crank-case oil at garages, other than by turning it into the sewer system, as reported by cities in the United States are: As an aid to burning city garbage and refuse; as fuel oil; oiling swamp lands for mosquito control; oiling dirt roads; oiling concrete forms; manufacture of paint; re-refining oil used in automobile engines; pouring on dumps [kind of dump not stated nor whether this may not in some cases be city refuse dumps so that the oil here is used to help burn the waste materials]. Some of the remarks received from various cities in the United States, Canada and Europe bearing upon the problem under consideration follow:

Seattle, Wash.—Gasoline vapor has been found at more than 100 places in the city's sewers, in many places in dangerous quantities.

Syracuse, N. Y.—We are bothered with considerable accumulations of grease and oil at our sewage-works.

Boston, Mass.—We have had several narrow escapes from serious accidents. Regular collection of crank-case oil and waste gasoline by the city under regulations, either by day labor or by contract, seems to be the best solution offered under present conditions.

Baltimore, Md.—A contract was entered into and the contractor is to be paid a stipulated amount for collecting all crank-case oil.

Milwaukee, Wis.—The city collects oil in a tank truck and uses it in the burning of its garbage. The city has some general ordinances which prevent [prohibit?] the owners of property from discharging oil wastes into the sewer system, but those ordinances are unenforceable.

Toronto, Canada—The five largest oil companies operating service stations throughout the city collect this waste crank-case oil periodically and return it to refinery. We are informed that credit is not given for the oil collected and that the value practically equals the cost of collection.

Winnipeg, Canada—The waste oil drained from automobiles and trucks at the different garages and filling stations is stored in small iron drums and taken away by the oil companies.

Paris, France—The mixture of oil and gas coming from garages and filling stations is treated by distillation and the oil that is gathered is again used for oiling purposes.

Breslau, Germany—Garages are required to maintain "separators." However, after a certain saturation point of oil and benzine, the accumulated material in the apparatus is poorly dissolved and let into the sewer from water power behind. For this reason another apparatus is needed with an automatic closing device and a device to deposit the material in separate receptacles.

Copenhagen, Denmark—Before waste water from garages and filling stations is allowed to enter sewers it flows through gasoline separators in which the gasoline is held back and can be collected. No provision is made for the disposition of waste oils.

Included in the main report already mentioned are extracts from a report by the U.S. Bureau of Standards on analyses of various waste oils submitted to it for examination. Two sentences from the Bureau of Standards report follow: "The results are entirely favorable and show that all the refined oils pass government specifications. Oils deteriorate in use, but when properly refined, may be as good as new. If a used oil is re-refined by a suitable process, the product may be as good as or even better than the original oil." A supplementary statement by Mr. Gordon credits Dr. Winslow H. Herschel, associate physicist of the U.S. Bureau of Standards, with "personal interest in the matter of re-refining and the completeness of his reports in this respect."

As to requiring intercepting traps in garages, the report points out that any "merely prohibitive regulation" designed to exclude oil from public sewers is "ineffective," because "its enforcement depends in too great a degree upon the spirit and respect of the public toward the intent of the regulation." The report also points out that oil gathered in oil traps "will naturally flow into the sewers."

Two Mixers Work Side by Side

Two mixers were operated side by side in paving 6 miles of 20-ft. Ohio roadway in order to complete the contract within the specified time of four months. The pavement consisted of a 5-in. concrete base with 3x12-in. monolithic concrete curbs, laid on an old 6-in. gravel road as a sub-base. A 1:7 mix was used on the slab and a 1:5 mix on the curb. Each mixer used a five-sack batch, maintaining an average ten-hour daily run of 1,200 lin.ft. Only 25 per cent more labor was required for operating the twin plant than would have been required for the usual one-mixer layout. The W. H. Ringwald & Sons Company, Chillicothe, Ohio, had the contract on the work.

Establishing a Garden City Near Chicago

Zoning and Grade Separation Factors in Layout of Subdivision Planned So as to Insure the Growth of a High-Grade Suburban Community—Separate Sewer System—Paving and Water

By Arthur W. Consoer
Consoer, Older & Quinlan, Consulting Engineers, Chicago

IN LAYING out the new suburban residential town of Westchester, Ill., 13 miles west of Chicago, there were no existing building uses to influence the preparation of the zoning ordinance, hence the plan could be made readily to segregate the zones for business establishments and apartment buildings. The total area embraced is 2,200 acres, and none of this was urban property two years ago. It is all in level country. This town, designed for a population of 98,000, has been planned, zoned and restricted to insure the growth of a high-grade suburban community, modeled after the English garden cities. No industrial property will be permitted. The amount of property zoned for business has been based on a frontage of 6 in. per capita, which is the average of business frontage in the Chicago suburban area.

Street Plan and Grade Separation—Adequate provision was made for wide streets to care for through traffic on main highways, in conformity with the Chicago regional plan. These major streets are 100 and 108 ft. wide. Residential streets are 66 ft. wide. Ample space has been dedicated for parks, playgrounds and school sites, as well as a civic center, around which it is intended to erect all of the public and semi-public buildings needed as the community progresses. Several sites for churches have been purchased. A general plan of the town is shown in Fig. 3.

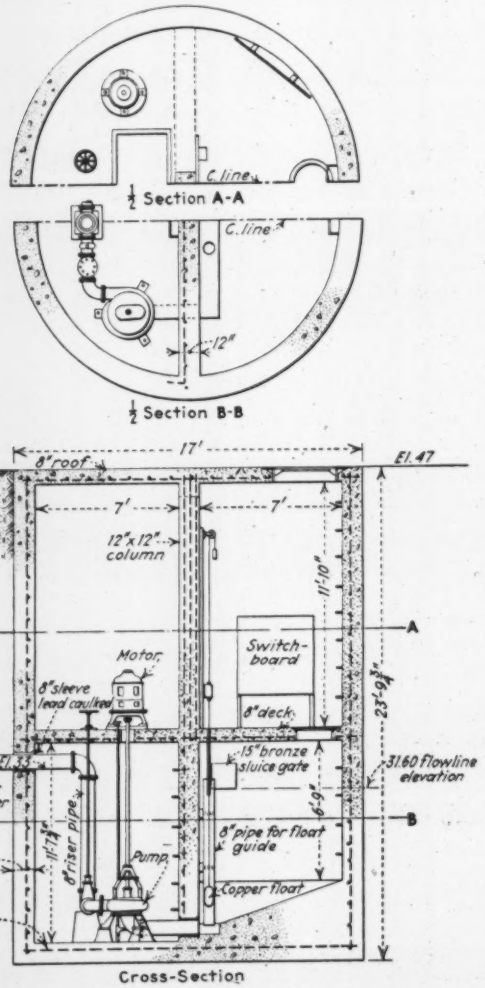


FIG. 1—SEWAGE PUMPING STATION

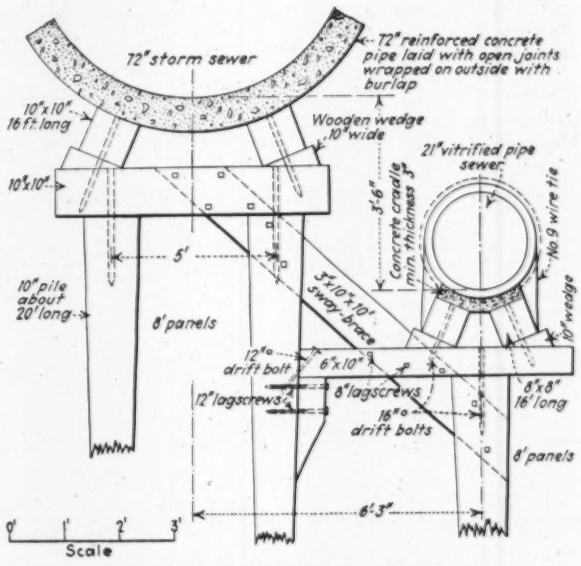


FIG. 2—MAIN SEWERS IN PEAT BOG

The street layout was also planned to facilitate present and future elimination of grade crossings of the Chicago Rapid Transit line through the town, without extensive track elevation or depression. This has been accomplished by laying out the streets parallel to the electric railroad for half a block on each side of the right-of-way, and all streets cross the railroad only at intervals of half a mile or more. The subdivision layout was planned to permit of easy access to stations located at these points, the streets on either side of the railroad permitting easy flow of automobile and pedestrian traffic to and from the stations. With the installation of track depression or track elevation at the station grounds, all grade crossings will be eliminated at much less expense than is ordinarily the case in the Chicago area where streets are laid out on a gridiron plan crossing the railroad at intervals of approximately ⅛ mile.

With the increasing use of automobiles, it is felt that there will be no inconvenience to the public in limiting street crossings over the railroad, while the advantage of safe high-speed service on this line will more than compensate for whatever disadvantage there might be in not having the more frequent crossings. A contract has been awarded for grade separation where the electric

line will cross Roosevelt Road. Separation of grades between the electric line and the Illinois Central Railroad has already been effected. All public utilities are being planned and installed previous to paving operations.

Concrete paving is provided by the city plan and zoning ordinance. On the major streets the roadways are 58 ft. wide, with provision for widening to 78 ft. They are 32 ft. wide on streets zoned for apartments, and 26 ft. on streets zoned for one-family homes. While the 26-ft. width may seem narrow, it was considered advisable to discourage traffic on these streets and to concentrate it on the wider business streets.

Drainage and Sewerage—The Westchester area has been adequately drained by deepening, straightening and widening Addison Creek for 8,160 ft. to Salt Creek. Bends in this stormwater channel were paved and lined with reinforced-concrete slabs. Sidewalk grades are at least 5 ft. above calculated high water in the channel.

It was evident at the outset that a double system of sewers would have many advantages. Combined sewers would have been very shallow, unless expensive pumping stations were provided, while basement drainage would have been complicated. Deep sanitary sewers were easily possible, as an intercepting sewer of the Sanitary District of Chicago was available as an outlet. Storm sewers could be built economically with numerous points of discharge into Addison Creek. With unfavorable soil conditions, the construction of a deep combined sewer system would have been much more costly than the construction of a double system.

Since the intercepting sewer before mentioned carries considerable stormwater at times, due to imperfect sewerage conditions in part of the area served, it was decided to build an automatic lift station where the Westchester sanitary sewers were connected with the interceptor. This station (Fig. 1), discharging the sewage into the interceptor, operates only when the latter is surcharged from carrying stormwater from other communities. It

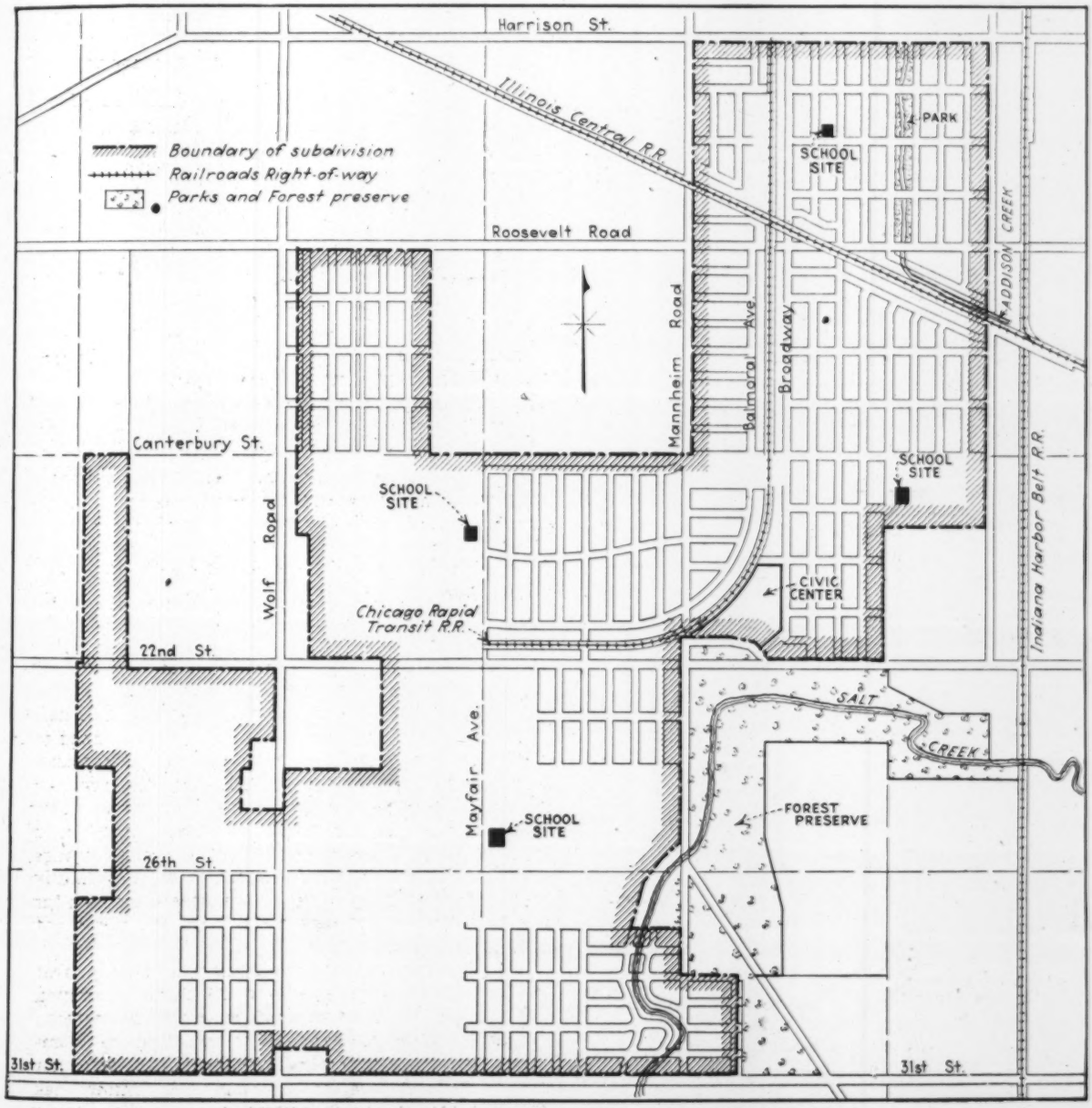


FIG. 3—LAYOUT OF NEW SUBURBAN TOWN OF WESTCHESTER, ILL.

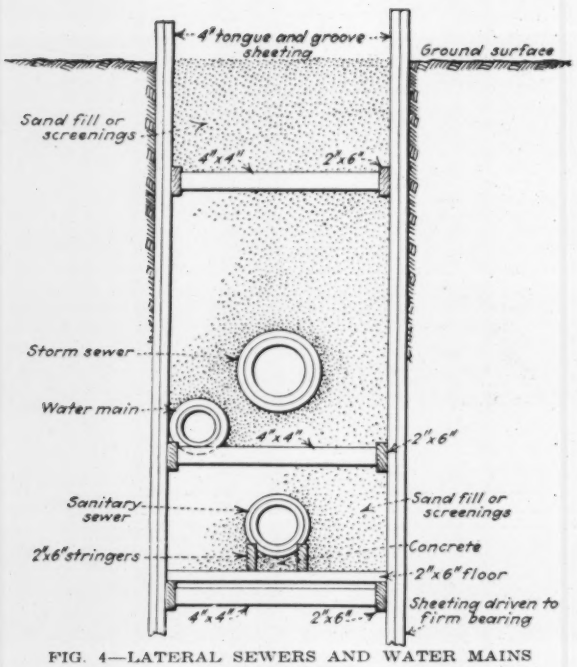


FIG. 4—LATERAL SEWERS AND WATER MAINS IN PEAT BOG

prevents the entrance of stormwater into the Westchester sewers and insures adequate basement drainage in the town. Asphaltic joints were used for all sanitary sewers and the specifications limited infiltration to 6,700 gal. per mile per day, although a considerable length of the sewers was laid through rather wet land. Liberal use was made of concrete cradles in deep cuts to prevent cracking of sewer pipe and consequent increase in infiltration flow.

A large storm sewer was built through the village to the western limits to intercept storm flow coming from the west, and the last 1,000 ft. of this sewer, along with the accompanying sanitary sewer, had to be laid through a peat bog. Here the soil for a depth of 20 ft. is a semi-fluid muck, below which is a coarse white sand that formed good bearing for tongue-and-groove sheeting and piles. The type of construction used (Fig. 2) cost $62 per foot. Lateral sewers in the same kind of ground were built as shown in Fig. 4. An inverted siphon (Fig. 5) carries the storm sewer under the rapid-transit line where a track depression project is now under construction at Roosevelt Road.

Water Supply—A 16-in. feeder main, 20,200 ft. long, of 16-in. centrifugal-cast iron pipe, connects the Chicago water system with the Westchester distribution system. The equipment includes a 500,000-gal. concrete storage reservoir, a booster pumping station, a 100,000-gal. steel elevated tank, and a distribution system of cast-iron pipe consisting of 10,875 ft. of 12-in., 26,935 ft. of 8-in., and 73,162 ft. of 6-in. mains, with necessary valves and hydrants.

Progress of Development—Underground work has been completed during the past sixteen months, and paving and building operations are under way. Plans and specifications and supervision of construction were in charge of Consoer, Older & Quinlan, consulting engineers, Chicago, with W. G. Mawhinney, Horace H. Smith, Alex McFadden and Aubrey Baber as resident engineers. Up to Oct. 1, 1928, $628,800 had been expended for water supply and $1,022,605 for storm sewers, sanitary sewers and dredging. Contracts have been let totaling $800,363 for concrete paving and $212,000 for street lighting. The total cost for water

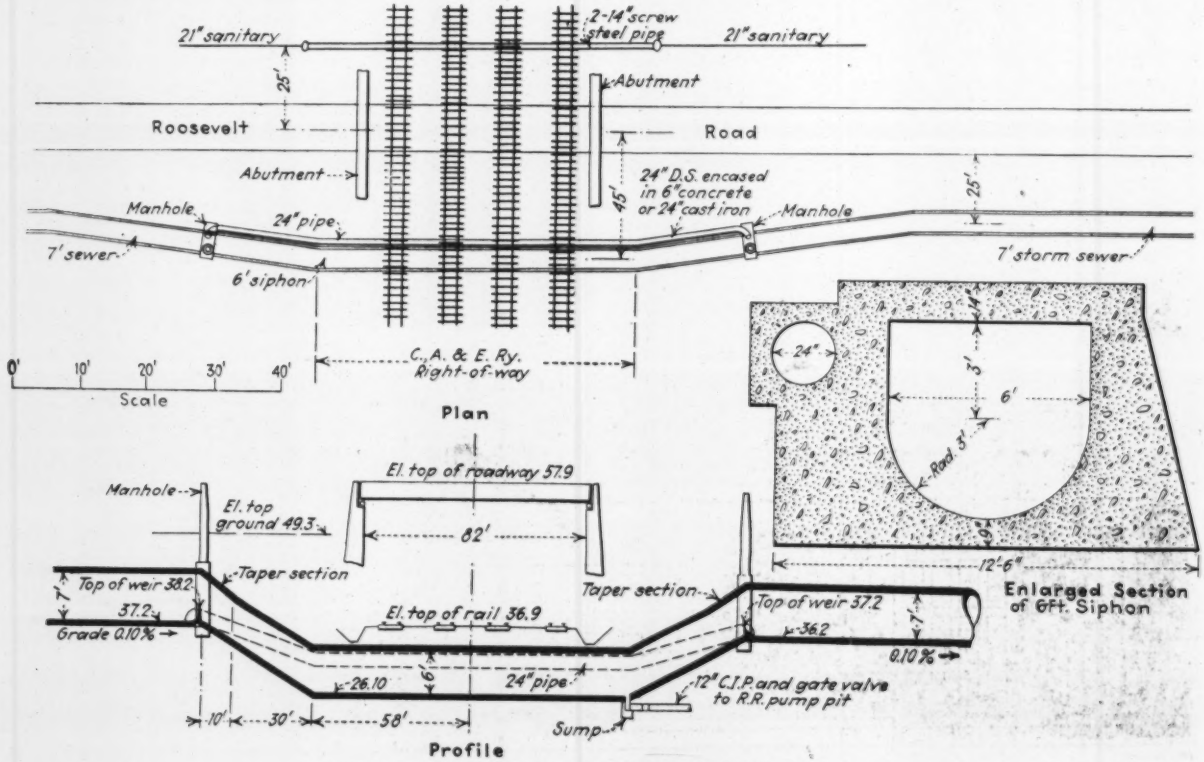


FIG. 5—SEWER SIPHON CROSSING RAILROAD

supply, sewers, paving and street lighting will be about $3,100,000 for the present improved area of 500 acres. The sewer and water systems were built by the L. E. Myers Company, Chicago. Paving was done by the Allied Contractors, Inc., Omaha, Neb.; Stark-Schneider Company, Chicago, and the Pickus Engineering Company, Chicago.

An interesting feature of this development is the fact that in less than two years the first 500 acres will have been transformed from virgin farm territory to a finished town with complete improvements and more than 100 homes will have been built and occupied.

Rapid Winter Construction on a Hydro-Electric Plant

Working Three Eight-Hour Shifts Saves 2½ Months at Chippewa Falls—Entire Structure Housed for Winter Work

WINTER construction work and rapid progress, speeded up from the original schedule, were features in building and equipping the Chippewa Falls hydro-electric plant on the Chippewa River, in Wisconsin. As noted in the description of this plant in *Engineering News-Record* of Jan. 17, 1929, p. 106, the construction work was started in September, 1927, and the schedule provided for its completion by Sept. 1, 1928. In view of the increasing demand for power, however, the work was speeded up so that the plant was put in service on June 15, 1928, or 2½ months ahead of the schedule. This change in procedure necessitated a revision of the progress chart which showed, for each classification of work, the date set for its completion and the monthly rate of progress.

Two types of cofferdam were built. The one along the upstream side of the power house and dam was composed of rockfilled cribs, the spaces between which were filled with stop-log panels. The upstream face of the cribs was sheeted, and soft earth or sand was then banked along the entire length of the cofferdam. The downstream cofferdam was built of similar rockfilled cribs, but they formed a continuous row and had a center core sheeted on both sides and filled with soft earth. On the upstream cribs was built a trestle with standard-gage track to facilitate delivery of heavy machinery parts and structural steel direct from cars. This track was used

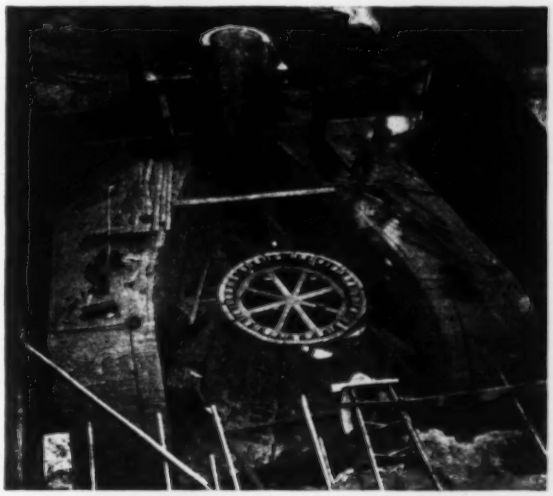


FIG. 1—FORMS FOR SCROLL CASE AND DRAFT TUBE

also for delivering materials to, and handling concrete from, the central mixing plant. On the downstream cofferdam was laid a narrow-gage industrial track which was used principally for the disposal of material excavated from the tailrace.

In the riverbed the rock was fairly clean, but the entire area was covered with boulders. In blasting, both tripod and jackhammer drills were used. The blasted rock was loaded partly by power shovels, but was mainly hand-mucked into skips and then loaded onto cars by means of stiff-leg derricks placed at convenient points. Because of the shattered condition of the rock bed much of the excavation for the cutoff trenches was done by the feather and wedge process, as blasting produced trenches that were not only irregular in contour and alignment but were much larger in extent than was desired.

An early examination of the site, as mentioned already, indicated that the rock was a high-grade granite of uniform quality, and the decision was made to crush the coarse aggregate for the concrete on the job. A crushing and screening plant was therefore installed, but when actual operations were begun much of the granite was found to be soft and partly decomposed. This

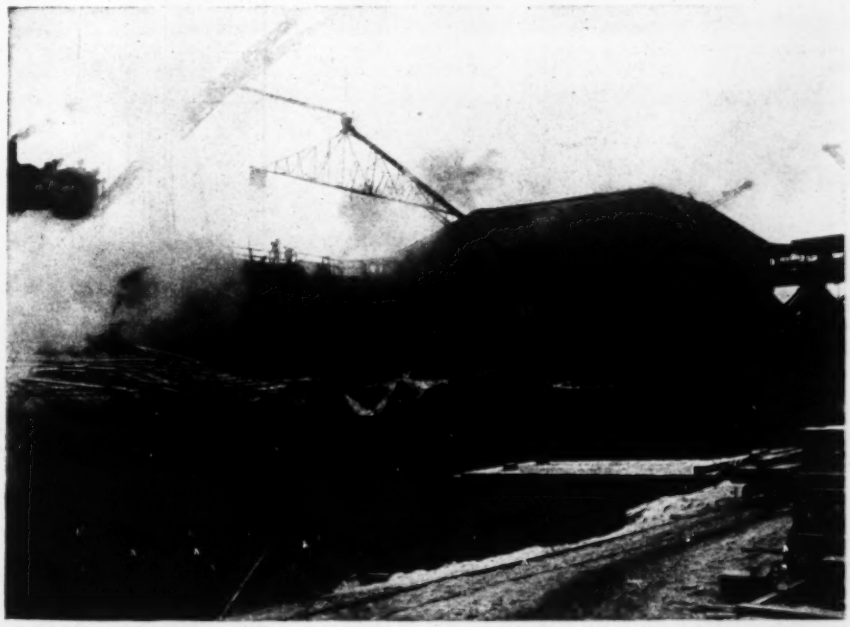


FIG. 2—WINTER CONCRETING; DAM ENTIRELY INCLOSED

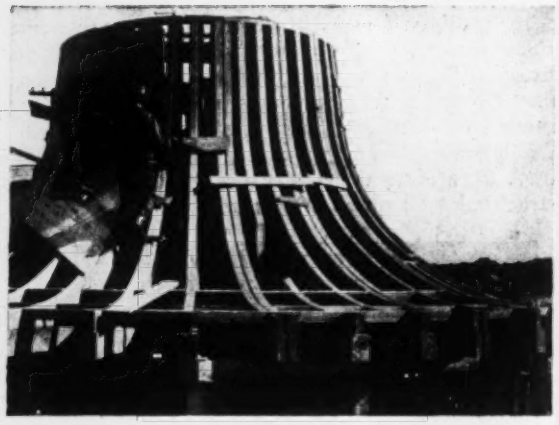


FIG. 3—MAKING A DRAFT TUBE FORM

necessitated careful culling of the material sent to the crusher and likewise required the hand-mucking rather than the power-shovel handling which had been contemplated. This fractured condition of the rock increased the difficulties of excavation and also caused a considerable increase in the quantity of excavation and concrete over the estimates. The total quantity of concrete poured approximated 30,000 cu.yd. and the excavated granite produced less than half the coarse aggregate required, making it necessary to purchase the balance.

All concrete in the dam and power-house substructure was proportioned by the Abrams formula, with strict adherence to the water-cement ratio law. Frequent determinations were made of the grading of the aggregates, and the proportions were varied as required to produce a concrete of maximum density. Three grades of concrete were mixed, designed to develop respectively 2,000 lb., 2,500 lb. and 3,000 lb. compressive strength per square inch after 28 days.

The central mixing plant comprised two motor-driven mixers of ¾-cu.yd. capacity. The coarse aggregate was measured volumetrically through batcher-hoppers which were fed from storage bins above. The sand was measured by means of an inundator, thereby insuring constant volume of sand and water and rendering unnecessary any attention to bulking. A mixing time of one full minute prevailed throughout the progress of the work.

Concrete from the mixer plant was delivered into bottom discharge hopper cars of 3-cu.yd. capacity, mounted on standard-gage trucks. Generally, however, the load was only 1½ cu.yd. per car. On the short hauls, two cars were used as a rule, but at times three cars were operated very advantageously. Gasoline locomotives were used, and for longer hauls a locomotive and one car constituted a hauling unit or train. The trains were operated shuttle fashion, so that there was almost constantly one car being loaded and one being unloaded.

All the concrete in the dam and some in the power house was poured directly from the hopper cars. The remainder was chuted into place from a tower. In spite of the fact that this work was done almost entirely during the winter months, very little trouble was experienced due to concrete freezing while in transit from the mixer to the forms. It was found that a temperature of 68 to 76 deg. F. in the concrete discharged from the mixer was sufficient to prevent trouble if the mass was kept constantly in motion. This was true even when the atmospheric temperature fell to as low as 20 deg. below zero. No concrete operations were attempted under more adverse temperature conditions. When chuting was resorted to, a slope of 1 on 2 usually proved sufficient to insure uniform flow for a fairly stiff mix.

Because of the generally severe weather conditions the entire dam and power-house sites were housed in with temporary structures built of timber and tarpaulins. These housings were heated by steam coils and were sufficiently commodious to permit the erection of forms and the building of such staging and falsework as was required. In addition to making better working conditions for the men, the inclosure also simplified the problem of concrete protection until the curing period had passed.

All formwork was of wood, the scroll cases and draft tubes requiring much intricate construction. With a view to economy, the forms for draft tube and scroll case, as well as for the dam and piers, were sectionalized to permit their repeated use.

Delivery of material and machinery was greatly simplified by the fact that the site is served by two railroads, both of which maintain fast freight service. This service was of decided importance in view of the fact that storage space was extremely limited. Machinery parts were frequently unloaded direct from cars to their ultimate location in the completed plant.

From the early construction period until nearly the completion date, work progressed 24 hours daily for seven days per week, with three eight-hour shifts. From this experience it has been concluded that a more economical and efficient arrangement would have been the employment of approximately the same number of men on two shifts. The difficulty of co-ordinating the efforts and ideas of three sets of foremen was considerable.

FIG. 4—TRUSSES CARRY FORM FOR SERVICE BRIDGE

The large number of men employed (about 1,700 at the maximum) naturally brought many transients to the city of Chippewa Falls, Wis., the normal population of which is about 9,000. The city's accommodations were thus taxed to the utmost. To relieve this condition a camp was provided for the use of such employees as desired to live on the work. This camp was of the most up-to-date construction, with a central heating plant and a completely electrified kitchen. Its maximum capacity was about 275 men.

Both the design and construction of the Chippewa Falls plant were handled by the Byllesby Engineering & Management Corporation, Chicago, under the direction of H. W. Fuller, vice-president in charge of engineering and construction; F. H. Lane, manager of engineering and construction; J. William Link, hydraulic engineer, and Stephen Wehner, assistant engineer; with W. T. Walker general superintendent of construction and W. H. MacArthur resident superintendent of construction.

Four Floors Added to Six-Story Building by Arc Welding

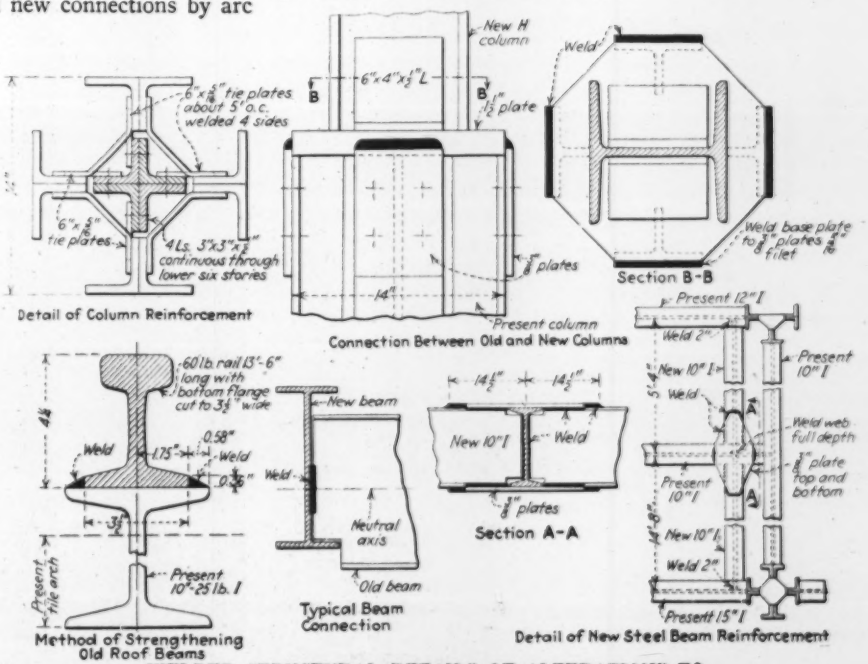
Tenants Undisturbed by Alterations—Old Gray Columns Strengthened by Built-Up Angle Cores—Old Beams Reinforced

ALTERATIONS recently made on the Rose Building, Cleveland, Ohio, erected in 1898, include the addition of four stories on top of a portion of the building which was originally six stories high and not designed to carry any additional load, construction of new elevator shafts in the old building and the general strengthening of the structure. No drawings were available showing the structural details of the old building and instead of uncovering enough of the structural frame to determine these details, it was decided to make only small openings in the old walls, cutting the old steel where necessary and making all new connections by arc welding. This plan also permitted the building occupants to carry on their business undisturbed.

In the accompanying drawing are shown some of the structural details that were used to effect the alterations. The old columns in the six-story portion of the building were of the Gray type, made up of four tee shapes held together by straps riveted to the legs of the tees, the center of the columns being open. To stiffen these columns and to increase their load capacity, cores in the shape of a cross made up of four angles were inserted. The new steel was then joined to the old at 5-ft. intervals by plates welded to the legs of the angles and to the legs of the old tees. Where the six-story columns were continued with new steel for the four additional stories, 1½-in. plates were welded to the top of the six-story columns as base plates to which the new H-column extensions were connected by 6x4x½-in. angles.

In constructing new elevator shafts in the old building the framing was cut with a gas torch and the new steel butt welded to the existing beams. Beams which carried the roof of the low section of the building were not deemed to be of sufficient size to carry the seventh floor, and 60-lb. rails were welded to the top flange of the old beams as stiffeners. Welded steel bar joists were used in the new addition, held in position by welding the ends of each joist to the beams and tied transversely by welding a ½-in. round rod to their bottom chords.

The Forest City Structural Steel Company, Cleveland, fabricated and erected the structural steel, using electric welding machines in doing the field welding.


Detail of Column Reinforcement
Connection Between Old and New Columns
Section B-B
Method of Strengthening Old Roof Beams
Typical Beam Connection
Section A-A
Detail of New Steel Beam Reinforcement

WELDED STRUCTURAL DETAILS OF ALTERATIONS TO ROSE BUILDING, CLEVELAND

Excess Condemnation to Be Studied

Excess condemnation, or the taking of more land than is needed for public improvements with the intention of reselling the excess at an increased value due to the improvements while at the same time controlling the use of the excess land, is to be studied by the National Association of Real Estate Boards. The practice has been legally authorized by constitutional amendments or otherwise in eleven states: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Maryland, Virginia, Michigan, Wisconsin, California and Oregon.

Tolls Removed From Columbia River Bridge

The interstate bridge across the Columbia River between Portland, Ore., and Vancouver, Wash., was made free of tolls on Jan. 1, although it is possible that legal suit may still be filed in protest. Removal of the tolls was made possible when Multnomah County deeded its title to the bridge to the Oregon State Highway Commission, Clark County on the Washington side having previously taken a similar step.

This Material—CONCRETE

An Article in Four Chapters

A Discussion of the Vital Problems of the Concrete Industry, Outlining Certain Obstacles to Consistent Quality Production and Indicating a Line of Progress

By Nathan C. Johnson
Consulting Engineer, New York City

IV—Effecting Economies by Study of Cements

In the Three Preceding Chapters of this discussion of concrete as a material, consideration has been first given to the general problem of making and merchandising concrete and to some common practices that may and do affect the quality and value of the merchandised article. Notice has also been taken of some of the causes of dissonance between engineer and contractor.

In Chapter II there was a discussion of standards as they have been with their lack of tolerances and the common disregard that these lacks of tolerance have naturally brought about.

In the third chapter the relation of aggregates and water to cement and to the mix as a whole were investigated in a rather novel manner in order to get the picture of the relationship that obtains in all concrete. At the conclusion of this chapter a specification was set down which has been thoroughly proved out in practice as bringing laboratory and field into closer accord, both by granting and also by limiting tolerances.

This fourth and final chapter will be devoted to pointing out as far as possible what may be done and what may not be done in the commercial use of cement beyond the general specifications before derived. The nature of the cementing substance and the processes of its formation will be traced through.

The Make-up of Concretes

ONE FACT sticks out with prominence and force in any study of any concrete mixture. The fact is that no matter how old the concrete may be, and although the sand and stone in the mixture are bedded into and attached to the cementing substance that results from the union of powdered cement and water, *these two materials have not in any way changed their nature.* They remain sand and stone for all time and possess at all times all of their original properties, as may be proved by dissolving away the cementing substance from around them, as by an acid.

On the other hand, *cement and water as embodied in the mixture have completely changed their nature.* The cement and water of any concrete or any mortar have both disappeared as such and have become a new substance. Try as we will or by what agencies we will, these united substances in the form of a new substance may not be used again, nor is this new substance of any utility except in the form in which it was originally molded. The thought comes at once that we shall make the most progress in the least time by forgetting all about sand and stone and concentrating our attention on the cementing substance which holds them together.

It is not necessary that we mold a special concrete or a special mortar under laboratory conditions in order to conduct this study. In fact, it is quite possibly better that we take a piece of concrete from almost anywhere. This would be concrete as it is and since thus far in this discussion we have inferentially dealt with concrete cast in forms and free of trowel manipulation or like special effect, let us assume that for this examination a chunk of concrete of perhaps 20 lb. weight has been spalled off from some near-by structure of mature age by means of a bull point and sledgehammer.

In this piece of concrete we have a whole world of information. Quite visibly it has sand and stone within it, and we know it is bound together by cement. Quite visibly also it has outward surfaces which have their own peculiar characteristics (Fig. 1). Less visibly, it has between the sand and stone that compose it the water-cement stuff that we desire to study. So to assist this study and to look at this stuff better, it is an old device to put a magnifying glass on it so as to make visible to our eyes some short-focus and magnified details, just as we might put a magnifying glass on print that is otherwise too fine to read.

Studying Hydrated Cement Pulp

When we do this, we have before us the appearance of Fig. 2. In this magnified field we have some sand

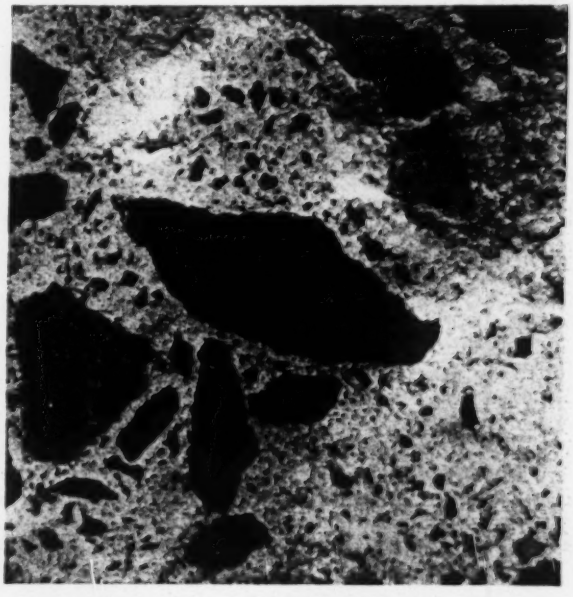


FIG. 1—A CHUNK OF ORDINARY CONCRETE
Showing stone and sand and cement pulp. Natural size.

grains, magnified to the size of stone. But as is proper to an investigation that is eliminating any study of sand and stone as such, these sand grains are only on the outer edge of the field.

Thus we have as our subject of close study a lot of whitish stuff lying between the sand grains; and in addition to this whitish characterstic, we may note that it is here and there peppered with specks of unhydrated cement, quite unmarred with water and existing in their original state.

Only by way of mention, it will be said here that the presence of these unhydrated cement particles is probably of the greatest importance to the endurance and life of the concrete, inasmuch as they continue to supply throughout a long period of years new cementing material by new unions with water which renew the destroyed or "hydrolized" cementing material that was originally derived from the first reaction of the finest particles of cement with water. Only by way of mention also, it will here be said that many of our misbehaviors in concrete are quite probably due to the fact that this "cement matrix" is lacking in these unhydrated particles so that there can be no restoration of cell life, as the old cell life is destroyed in the processes of time and of nature.

But for purposes of the present study attention will be concentrated on the whitish material, quite disregarding the sand grains and the unhydrated cement particles.

There is a world of information to be had from this study, and it is most useful information. If, instead of the conventional way of disrupting this cementing mass under pressure, we substitute gentler methods, we may likewise obtain some unique and likewise very useful information. For instance, if we take a fine needle point and incise or cut with this needle this cement mass, we shall find that it is a pulpy sort of substance; and

FIG. 2—THE CEMENT PULP OF CONCRETE IN CLOSE VIEW

Note the particle of cement (at center) unhydrated after fifteen years, the sand grain at the lower left and the mass of cement pulp surrounding the unhydrated cement.

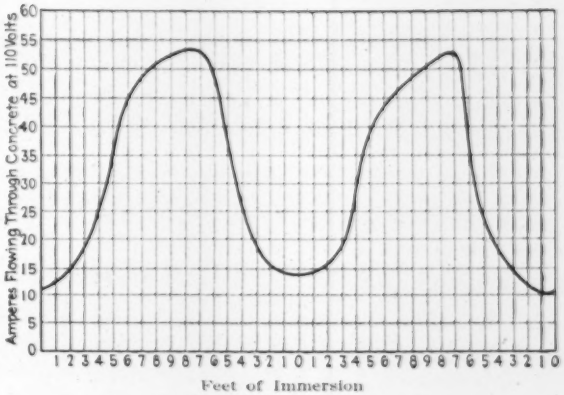


FIG. 3—ELECTROGRAPH OF PERMEABILITY OF CEMENT PULP OF 1:1½:3 CONCRETE BY SALT WATER

Note the taking in and giving off of water by a very dense concrete.

we shall further find by comparison with other substances that as to hardness it has much the characteristics of a good limestone.

Of course, it is not fair to investigate only one mass of this substance, but if we investigate, for instance, neat cement, and if we further investigate rich mixtures and lean mixtures and wet mixtures and dry mixtures, we shall find a world of difference. But at the same time we shall always revert to this same comparison and find a very hard pulp. For purposes of word picturization, this term "cement pulp" will therefore be used in this discussion, as it gives us a better idea of the properties of this substance than possibly any other term. Inasmuch as there are very hard and indurated pulps well known to us as well as soft pulps, there is no derogation in the use of the term "cement pulp."

To compass all the investigation that is necessary and to set it down in detail in a brief article would be impossible. It will be sufficient to condense in brief form the findings that will inevitably be had by any examination of this cementing pulp.

Absorption and Protective Means

The first finding that we have is as follows:

1. *The cement pulp will absorb water by and throughout its own pulpy mass and quite regardless of physical pores.* This means that while concretes may not physically leak, they will take in water; and in thus taking water they naturally will take in any substances that may be dissolved in water. And that is an observation which is confirmed in practical and every-day life. For instance, concretes exposed to sea water take in the sulphates of the sea water quite regardless of whether or not the concrete is highly dense; and they will transfuse this water plus the dissolved salts throughout the entire mass by reason of the nature of this pulp which is formed from cement and water.

We may also confirm this by measurement on existing structures, as for instance by the electric current. This mode of investigation is entirely impersonal, and as the tides rise and fall a penetration diagram will be obtained like Fig. 3. This explains in part why so many water-exposed structures get into trouble and why protective means are advisable regardless of how cleverly we may have compounded or placed our concrete.

But when we come to protective means and investi-

gate their use on the pulps visually before us, we find a rather peculiar thing. Protective means ostensibly should be of a water-repellent variety, such for instance as oils, since oils and water will not mix. But when we apply oils with the pulpy mass before us we are confronted by the fact that:

2. *Oil will penetrate the physical pores of the mass but will not enter the pulp itself and the pulp will continue to absorb water after the oil is applied, as freely as before the oil was applied.*

Now, this is an awkward fact, for it apparently rules out a large number of substances that we might hope would be efficient protective means. Yet this result might be expected, for the pulp is always permeated with more or less water, inasmuch as a certain amount of water is necessary to its existence. Since oil and water will not mix, we may not hope to penetrate the pulp of concrete by these means. We must use something that has profound affinity for water, and this remains to be developed.

Efflorescence

If we dry the pulp out by artificial means, we shall be confronted with another fact, and that is that:

3. *The pulp of cement will give off water down to its necessary minimum as freely as it will take in water beyond that minimum, up to about its own bulk of water.*

This explains in large measure why it is that we have efflorescences on concrete where we often desire an entirely clean surface. That is, since concretes are free to absorb water in their pulpy mass and since they are free to give off water, the evaporation of that water brings to the surface a large amount of dissolved salts which come from the body of the concrete and are deposited on the surface when this evaporation takes place.

We find practical application to all these things in structures in one climatic exposure as opposed to another. For instance, in a region of almost constant humidity such as Los Angeles we may maintain our concrete structures in a clean and prepossessing condition. On the other hand, in a climate of wide extreme, as for instance in the vicinty of New York, the same concretes would speedily have a most distressing appearance which often seriously depreciates their value.

So it is seen that by this study we are approaching the dollar sign very materially. We are also learning behaviors and natural limitations of concrete which we should recognize. And if we so recognize them, we may take advantage of conditions as they are and not as they are supposed to be, and we may not only produce a more satisfactory construction of any form in concrete but we may go farther and produce a structure of values which never before have been assumed to exist.

Cement Pulp and Bonding

Reverting, therefore, to further study of the pulp, we shall find this as a further fact:

4. *Set and hardened cement pulp refuses to bond, except for a very limited time, with new cement mixtures applied to it.*

Cement pulp does not necessarily lie only between sand and stone. Cement pulp lies on form surfaces and top surfaces; and it also lies on the surfaces of sand and stone. It is an axiom of making concrete that clean stone and clean sand must be used. Yet in the field there is the constant assertion that cement-covered stones, as for instance at the top surface of a floor slab, are capable of permanently bonding with a new cement mixture applied in the topping coat. Acres of loose and cracking floor toppings prove the contrary.

Books might be written on the subject of concrete floors and the making of concrete floors. But it may be stated that a large part of the difficulty that is encountered in the putting of top floors over underslabs and the putting of other top finishes on underbodies, as for instance in curbs and steps, sidewalks and a variety of other uses, comes from an overconfidence in the assertion that new and old can and will bond one to the other effectively and surely and for all time. The simple fact of the matter is that a temporary bond may be obtained but that there will be a sharp plane of cleavage between the new and the old wherever this is attempted.

For further light on this subject we might revert to the laboratory. No laboratory man would countenance

FIG. 4—SOLUBLE SALTS COMING OUT OF THE CEMENT PULP OF CONCRETE AND LEFT BEHIND BY EVAPORATION

This happens in greater or less degree on every concrete surface when evaporation sets in.

for a moment nor would standard specifications countenance for a moment the making of cylinders in three or more sections, allowing each section to set before the subsequent section is poured. In like measure no cylinder molded in two parts with a plane of casting at, say, a 30 deg. angle would be admitted as indicative of the value of a concrete, because it would be known beforehand that under pressure or under any stress whatsoever the two parts of the cylinder would slide one along the other with an entirely deceptive and low-value result. In fact, if we but waited a little time we all know that they would fall apart.

Yet on the job, where concretes are far less perfect, there is a constant assertion and insistence that each individual engineer, foreman, superintendent and laborer is capable of producing this bond in a satisfactory degree.

although it has never yet been done to the writer's knowledge.

But on the other hand, it was before pointed out that the sand and stone in the mixture are capable of repetition of bonding with new mixtures, if we wash them clean of the cement pulp with which they are covered and to which they were originally attached in the first casting. If, then, we were to vary our procedure and wash to a sufficient degree these surfaces, we might reasonably expect to get bond and to get an effective bond.

The commercializing of these facts is of the highest importance, for it enables that desired end to be reached of permitting the contractor a greater time latitude than he has enjoyed in the past, so that he may conduct different portions and sections of his operations at different and convenient times.

Practical Facts About Mother Liquor

But attention may not be solely confined to the cement pulp as a substance. It is equally of importance to find how this cement pulp came into being and in what manner the formation of this pulp affects our costs and the sequence and ultimate value of our operations.

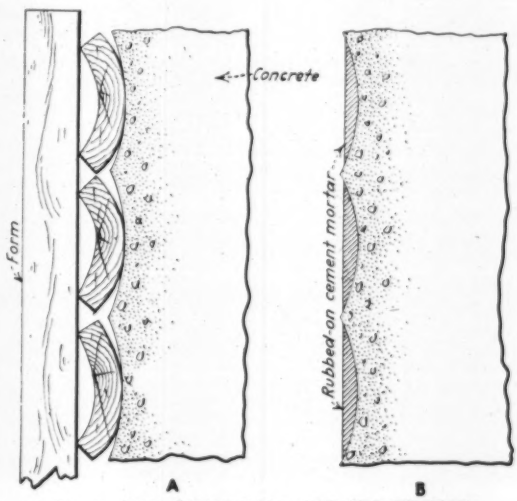


FIG. 5—FORM WARPING AND ITS EFFECT
A—Showing warping away of form boards due to resinate formation at inner face of forms. *B*—Showing smearing in of shallows between ribs due to rubbing the face. (Warping purposely exaggerated.)

In Chapter III the "mother liquor" was spoken of—a strongly alkaline solution formed almost as soon as cement and water came together. It was stated, and the statement is fact, that in this mother liquor the secondary products of the hydration of cement diffuse and spread, and that without it there would not be much hope of success in concrete.

Two things are in evidence in this statement.

The first is that much depends on the *intensity* or concentration of this mother liquor. This is fact, for if some substance, such as the pure mother liquor itself, is added to a normal cement-sand-stone mixture, we may obtain from three to four times as rapid hardening by this means as would be had without this addition. This would mean dollars, for forms could be stripped earlier, floor and pavement surfaces could be trafficked earlier, cement products could be used earlier, time would be saved, and time means money. The author's experiments indicate definite possibilities in this direction.

The second fact in evidence through this emphasis on the loaded fluid that is termed "mother liquor" and as it exists in all concretes before they have set is that *all* the soluble materials in concrete—and there are many of them—must be and are in substantial solution before they can react one with another to form the material that has been termed "cement pulp," which material in turn binds in the unalterable sand and stone to form our useful mortars and concretes.

We must, then, imagine any commercial concrete, whether in large section or in small, as being at one time composed of a large excess of fluid heavily charged with soluble salts. These salts are lime salts, sodium salts, potassium salts, aluminum salts and other salts, *which serve a temporary purpose only and do not enter into the true cement reaction.* What becomes of these salts, suspended in this excess fluid; and in what way is their existence of commercial interest or importance?

When concrete becomes rigid, forms are removed. When forms are removed, any fluids that have not leaked out are evaporated out and leave behind them, at the form surface of the casting, grams per square inch, ounces per square foot and tons per total surface area of foreign materials, highly alkaline in character, able to crystallize and, in crystallizing, capable of exerting disruptive pressures, which, sad to say, take off, remove and quite unfeelingly blotch the very nice surfaces that have been put on as a finish at considerable pains and expense.

Although it may take a year or so to do this to full extent, it is quite probable that appearances (see Fig. 4) have cost more money and have done more harm to concrete in the minds of the public than any other one thing.

So again we have dollars. And from this same cause we have other dollars of loss—dollars possibly without number.

Something About Forms and Faces

For instance, one plague that afflicts contractors is cost of forms. Cost of forms and mother liquors and alkaline crystallizations seem far apart, yet they are tied in together most simply. Wood gets its staying power and elasticity and usability from the resins contained in its cells. Alkalis, such as exist in mother liquors, are avid for resins and form expansive compounds *in the wood*, such as resinate of lime. It is for this reason that form boards always *warp away from concrete*, regardless of their grain; and it is for this reason that the surfaces of concrete, intended to be plain, are a series of scallops like Fig. 5. And these scallops are not only unsightly but further are difficult and costly to finish, for "carborundum rub," as usually done, means a smearing in of these shallows and reappearance of the protuberant ribs as soon as—and that usually is quite soon—the thin sections of rubbed-on stuff fall away, either through natural warping or through the pressure of the crystallizations behind them.

Further, repeated doses of mother liquor, permeating the forms on each repeated use, soon pull all the life-giving resins out of the wood, and when that is accomplished the form snaps and maybe the concrete "covers the earth" in a most provoking manner. Ten uses of forms used to be about the limit. But by protecting them by an impermeable coating more than 30 uses of forms are being commercially obtained on several large-scale operations. That is a saving worth while—so again, we have dollars.

The citation of possible financial gains might be con-

tinued indefinitely. Many of them are commercially proved and very few of them are in any degree speculative.

Future Possibilities

For instance, it has been mentioned that the first six hours after wetting cement are the most critical hours in the life of the structure. In this period occur all manipulations, and the more concrete is studied the more the influence of manipulation as performed by men on the ultimate result will be realized.

In a previous paragraph it was mentioned that at the beginning all the materials of cement were in solution with water. This gives us an opportunity for manipulation by means other than manual, which should not be overlooked. In this solution period we may do such a wide variety of things that affect the ultimate value that there seems to be no end in sight. We may arrest the development of cement during this period or we may accelerate it. We may cause the substance to change its nature even to the point of becoming rather elastic and flexible instead of simply standing by and letting it become hard and brittle. We may do a variety of other things which are of the utmost commercial importance. The space of this article does not permit an exposition of these matters in full. The point now is that the future of the concrete art lies largely in study of such possibilities.

In this first six hours also, it should be noted, it is quite probable that a majority of the crackings or other faults that may be seen in certain classes of concrete construction originate. It is probable that at no other period in the life of cement is there such an enormous outpouring of power through the wetting of portland cement. This is evidenced by the tremendously high rate of strength gaining that is noted in any testing of cement. It is possible that this period extends over 30 hours under certain conditions of temperature. The exact limit cannot be defined without knowing all the conditions and the particular cement being worked with.

But this fact should be recognized. It is quite probable that the internal stress in any concrete far exceeds any external stress that ever will be put upon it. For this reason we may not and cannot reinforce against all cracking, because to do so would leave very little concrete and make the mass of whatever section almost entirely of steel.

Reinforcing has been given little place in this discussion thus far, not because its existence and utility have been forgotten but because we have been dealing with concrete as a material. Concrete as a material is by popular assumption incapable of taking tensile strength, and for that reason reinforcing is put in. But at the same time this view may reasonably be questioned, and if ever we are to have less and more economical sections, one goal to be striven for is the introduction of a reliable tensile strength in concrete such that the amount of steel required for a given section may be cut down. It seems quite probable that this may be done.

Conclusion

And in conclusion, it is desired to emphasize that the most important thing in any concrete is men and the attitude of mind of men and the result it has on their acts and actions in the formative period of concrete.

The engineer must first of all know his stuff. He must embody that knowledge in specifications, and these specifications must be such that the end desired to be served shall be well served by the producton of an article under the specifications which will particularly meet the needs of that requirement.

It is not sufficient to issue a blanket specification for strength alone. Strength, as has been pointed out, is almost automatically obtained and is only one of the many qualities which concrete must possess in one service or another. If we turn away from strength, we inevitably run into a study of the material far more extensive than the space of this article has permitted to be put down. And when we run into a study of the material, we run into a study of auxiliary substances such as waterproofing or other things of like character, and when we begin to investigate these a field of almost unlimited possibilities opens before us.

Sewage-Treatment Requirements for Jersey Ocean Towns

A MINIMUM degree of treatment for the sewage of seashore municipalities in New Jersey was fixed on Jan. 8 by the State Board of Health. The resolution, which affects about twenty municipalities and one sewer company, calls for at least "sedimentation and chlorination, the settled and disinfected effluent to be discharged" into the Atlantic Ocean through conduits extending 1,000 ft. or more "from mean low-water mark."

The resolution recites that it is based on investigations which have shown that sedimentation alone "is no longer efficient and satisfactory for the protection of the health and comfort of users of the waters of the Atlantic Ocean for recreational purposes, including bathing."

In a letter to *Engineering News-Record* from H. P. Croft, chief engineer New Jersey Department of Health, it is stated that:

> The action is taken upon detailed investigations of sewage-treatment plants, bacteriological examinations of surf samples and observation of the effect of the plant effluent upon the receiving waters. The conclusion formed was that the increased pollution of the surf waters is produced by (1) the increased population contributing to the sewage systems; (2) the construction of jetties for shore protection work and probably by the increased population using the waters for bathing purposes.

The Long Branch Sewerage Company and the borough of Monmouth Beach must provide sedimentation and chlorination, but plans for the works required of the company have already been approved by the State Department of Health. The city of Long Branch must enlarge its plant and intensify the treatment now practiced. Other places that must enlarge their plants and chlorinate are Allenhurst, Asbury Park, Beach Haven, Bradley Beach (two plants), Deal, Ocean Grove, Sea Girt (municipal) and Spring Lake (two of three plants).

Chlorination alone (from May 15 to Oct. 15) is demanded at Avon, Belmar, Lavalette, Manasquan, Neptune City, Neptune Township, Ocean Township, Point Pleasant, Sea Girt (State Camp), Sea Side Heights and Spring Lake (one of three plants).

Traffic Through Panama Canal

During the calendar year ended Dec. 31, 1928, a total of 6,334 commercial vessels, paying tolls aggregating $26,375,962.41, passed through the Panama Canal. The daily average number of transits for the year was 17.31 and the daily average tolls collection $72,065.46.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Percolation and Internal Stresses in Dams

REVIEWED BY A. C. JANNI

Consulting Engineer, Park Row Building, New York City

PERMEAZIONI D'ACQUA e Loro Effetti nei Muri di Ritenuta—By Ing. Oscar Hoffman. Milan, Italy: Ulrico Hoepli. Paper; 6x9 in.; pp. 125; 36 line cuts. 15 lire.

In the theory on dams, as treated by early authors like Castigliano, Kiel, Lieckfeldt, Levy and Pelletrau, percolation, as affecting the strength of the masonry of a dam, was disregarded. It is only recently that some few hydraulic engineers have taken up the study of this question in a scientific way and have published works on this subject.

Fillunger was the first, so far as the writer knows, to publish an important theory on the percolation of water and its effects on masonry. His theory is based on the mathematical investigation of the following two laws: (1) Hydrostatic internal pressure against the periphery, or surface, of the pores of a mass; (2) friction among the particles of water due to viscosity.

In the book before us, the author begins his research by admitting that the Darcy principle of percolation of water through soil holds good also in the case of masonry. In this admission he merely follows Professor Fantoli's conclusions. He makes a clear exposition of the principle and of the mathematical theory governing it. He then proceeds to describe the damaging effects of percolation through cement mortar caused by the washing away of the free lime contained in the mortar and, finally, presents a critical study of the theory on percolation, as published by Fillunger, reaching the conclusion that all the effects of this phenomenon on the masonry of the dam, which result in internal stresses, are purely local—that is, they balance one another—therefore they do not affect the static of the structure as a whole, but they affect the strength of the material locally. For this reason he condemns the modern practice of building dams of reinforced concrete of comparatively light thickness, without protecting the upstream face of the dam with an effective waterproof material. Since, as the author states, there is no waterproof material to withstand the hydrostatic pressure on the upstream face of a dam, it is necessary for the designer to take into account the effects of percolation and to correct accordingly the internal stresses obtained by the usual methods of dam designing.

Afterward the author presents an original theory by which he demonstrates that the internal stresses in the masonry of a dam, due to percolation, have a close analogy with those developed by changes of temperature. The results obtained by the theory on percolation have been applied by the author in the design of several types of masonry dams and the internal stresses have been computed accordingly.

In support of this theory he mentions, among others, some interesting tests conducted by Föppl, in which nine cylinder specimens (140 mm. long, 84 mm. diameter) capped at both ends with flat brass rings, each ring covering 50 mm. of the height of the cylinder, under a hydraulic pressure of from 2 to 26 atmospheres, all broke along a plane normal to the axis of the cylinder. In seven cylinders the break occurred in sections between the two end rings, and in the remaining two the breaks, although regular as in the others, occurred in the zone of the cylinders covered by the rings. While Föppl laid the cause of this remarkable irregularity in the breaking point of the specimens to some imperfections of his testing machine, Fillunger, by applying his theory, found that the tensile strength in the sections of failure had been 0.4 times the external hydraulic pressure and that this tensile strength had been of from 0.8 to 10.4 kg./cm^2—values, as he remarks, quite in keeping with the usual tensile strength of cement mortar. The author, applying his modified theory, finds the tensile strength to have been of from 1.4 to 18.0 kg./cm^2. Apart from these discrepancies in the results of the author and of Fillunger, the fact remains that in either case the results are impressive.

There are reported other similar tests made by Rudeloff and Panzerbieter, by Arp and Gave and by Fillunger himself, all bearing upon the same question, but they will be omitted here for lack of space. It will be pointed out only that the tests conducted by Fillunger were made to demonstrate that these failures were not due to a chemical or mechanical action of the water percolating through the mortar, as might have been surmised, but were due to internal tensile stresses caused in the mortar by the percolation of water under hydraulic pressure.

The author has devoted his book to this complex problem and has treated it scientifically, which makes it well worth reading. Some of the difficult questions, which are often left to the personal judgment of the designer, have been here dealt with in a rational way. The book may not be considered the final word on this subject, but it marks an important step forward in this difficult field of engineering.

Dr. Waddell's Later Addresses

REVIEWED BY LEWIS E. MOORE

Consulting Engineer, Boston, Mass.

MEMOIRS AND ADDRESSES OF TWO DECADES—By Dr. J. A. L. Waddell, Consulting Engineer. Edited by Frank W. Skinner, Consulting Engineer. Easton, Pa.: Mack Printing Company. Cloth; 6x9 in.; pp. 1174; frontispiece portrait of Dr. Waddell. $5 postpaid.

One of the great troubles with the engineering profession is that most engineers suffer from an inferiority complex. Presumably (the reviewer's own complex almost made him say possibly) this comes from intimate dealing with the laws of nature. The engineer of necessity subordinates himself to the immutable laws of nature, and then carries the same subordinate attitude (or inferiority complex) into his dealings with his fellow men, whom he thus automatically (and generally wrongly) subconsciously regards as his superiors. So long as this attitude of mind is held by engineers, just so long will they fail to take the place in the world's affairs to which their labors and attainments justly entitle them and just so long will they continue to be subordinate to their mental inferiors.

The reader may ask what the engineer's inferiority complex has to do with a book review; but in this case it has everything to do with it. One suffering from an

inferiority complex would not be apt to consider his brain-children sufficiently valuable to be preserved in permanent form. Dr. Waddell, fortunately, is free from any taint of an inferiority complex; and this freedom has given him the courage to allow his memoirs and addresses of the last 22 years to be published in a single cover, for those who will to profit.

The book in general brings down to date a previous volume entitled "Principal Professional Papers of Dr. J. A. L. Waddell, Civil Engineer," which was published about 1905. Approximately twenty pages of the present work are devoted to synopses of the preceding "Principal Professional Papers." The remainder of the book comprises 68 papers and discussions and is divided into eleven groups covering the engineering profession, ethics, technical education, engineering literature, alloy steels, economics, bridge construction in general, contracts, railroad subjects, matters Chinese, and miscellaneous topics.

A number of the papers have been published elsewhere, notably the one on "Nickel Steel for Bridges," which appeared in the *Transactions* of the American Society of Civil Engineers for 1909. The original paper has been condensed as much as is possible without injuring its continuity and object.

The discussions of papers by other authors naturally suffer somewhat because of the absence of the original paper. In such cases the editor has endeavored to fill the gap by a brief synopsis of the statements which provoked the discussion. Several of the papers are addresses which the author has given to technical students at various institutions of learning.

When an engineer of long and varied experience is willing, as in this case, to epitomize his career for the benefit of the engineering profession, the result cannot fail to be of much value to some and of some value to all.

As Women See It

AN OUTLINE OF CAREERS FOR WOMEN: A Practical Guide to Achievement—Compiled and Edited by Doris E. Fleischman. Garden City, N. Y.: Doubleday, Doran & Co. Cloth; 6x9 in.; pp. 514. $3.

Of some 40 careers for women sketched in this interesting book the following may be noted: Architecture, by Marcia Mead; Civil Engineering, by Elsie Eaves, director of surveys, *Engineering News-Record;* Industrial Engineering, by Lillian M. Gilbreth, president, Gilbreth, Inc.; Railroading, by Margaret T. Stevens, associate editor, *Baltimore & Ohio Magazine.* The section on Civil Engineering deserves commendation as a classified summary of the work of the civil engineer, with the chances for women in that field kept in the background but clearly and cautiously put.

Unique Group of Bridges

THE BRIDGES OF PITTSBURGH—By Joseph White, Engineer, Department of Public Works, Allegheny County, Pennsylvania, and M. W. von Bernewitz, Mining and Metallurgical Engineer, U. S. Bureau of Mines. Pittsburgh (Crafton Station): Cramer Printing & Publishing Co. Boards; 10x12 in.; pp. 113; 3 folding maps and many halftones. $5.

Pittsburgh has for decades possessed a group of bridges unique in interest for their variety of type and originality of design and appearance. Recent years have fully maintained this interest, for both city and county have added a large number of noteworthy structures. White and von Berenwitz now make a pictorial and descriptive survey of these bridges available to the engineer at a distance. They have done an excellent piece of work. The absence of engineering drawings is compensated for by a wealth of photographs and sketches, showing not only the bridges of today but many of their predecessors, even down to "the first bridge at this site." By including this historical element they provide valuable data for a better appreciation of the long course of development through which the bridge engineer's art has progressed within the last century. It is to be hoped that the work will find a permanent place in every technical reference library.

A Textbook on Civil Engineering

REVIEWED BY M. S. KETCHUM
Dean, College of Engineering, University of Illinois, Urbana, Ill.

CIVIL ENGINEERING: A Textbook for a Short Course—By Lieut. Col. W. A. Mitchell, U. S. Army, Professor of Engineering, U. S. Military Academy. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 718 + Index of 17 pp.; line cuts and halftones. $6.

In the preface the author states that this is a textbook prepared especially for the cadets of the U. S. Military Academy. The book is a revision of the textbooks written by Colonel Wheeler in 1884 and Colonel Fiebeger in 1904. The author also states: "As the principles of civil engineering have not changed, this text in many pages uses exactly the text and figures of Colonels Wheeler and Fiebeger."

The book is divided into four parts: Mechanics, Building Materials, Component Parts of Structures, and Engineering Structures. The topics include theoretical mechanics, mechanics of materials, hydraulics, engineering materials, masonry construction, foundations, buildings, bridges, dams and retaining walls, water supply, sewerage and sewage treatment, railways, highways, city engineering, construction equipment, and specifications.

The book appears to be intended to be merely an outline of a course in civil engineering, to be supplemented by outside reading of the many references given at the ends of most of the chapters. The text contains many problems to be solved by the students.

With the present state of the art and science of civil engineering, it is practically impossible to treat adequately in one volume the fundamentals of all the subjects covered in this book. For the most part the treatment is satisfactory, considering the limited space. Several of the chapters, however, are fragmentary and sketchy. The chapters on buildings and bridges are the least satisfactory and would require much outside material to give the student a working knowledge of these subjects.

The illustrations are not up to the usual standard. In addition, some of the cuts appear to have been poorly selected for the purpose intended and others occupy too much space. This is especially true of the plan of the lighthouse, p. 279; the steam hammer, p. 319; the halftones of a section of a building, pp. 378 to 381; and anchors, p. 382. These cuts have a limited value and occupy space that should be devoted to more important subjects.

The continuous beam and the calculation of the stresses due to moving loads on beams receive very full treatment, while the calculation of the stresses in bridge trusses due to moving concentrated loads is omitted. With the limited treatment of bridge design the discussion of cantilever arch, suspension and movable bridges would not appear to be justified.

The chapters on water supply, sewerage and sewage treatment, highways and railways cover the subjects in

quite a satisfactory manner. These chapters will be appreciated by the reader who wishes to obtain a brief and accurate summary of these fields.

While the book has evident limitations, on the whole the author has done a very creditable piece of work.

Advances in Handling Employees

REVIEWED BY CHARLES R. GOW

Consulting Engineer and Contractor, Boston, Mass.

LABOR MANAGEMENT—By Gordon S. Watkins, Ph.D., Professor of Economics, University of California at Los Angeles; Personnel Counselor, Title Insurance & Trust Co., Los Angeles. Chicago and New York: A. W. Shaw Co. London: A. W. Shaw Co. Cloth; 6x9 in.; pp. 726. $5.

The remarkable progress which has been made in industrial efficiency over the period of the last two decades has been the result chiefly of improvements in mechanism and operating procedure. Undoubtedly there is still opportunity for much added accomplishment in this field. It seems probable, however, that future gains in this direction will be somewhat limited in scope as compared with past performances. At all events it cannot be expected that the accelerated progress of recent years in this regard will be maintained indefinitely.

There is a strong and growing inclination today among the business and industrial executives of this country to appreciate the possibilities of securing equally remarkable attainments through a more scientific approach to the human elements of business. The investigation of industrial relations cannot be said as yet to be out of the laboratory stage. It is true that much pioneer work has been accomplished, that many interesting experiments have been recorded in isolated instances and under varying sets of circumstances and that research work of a valuable character has been undertaken, but it cannot be said that there has so far been established any convincing set of data which can be recognized as constituting a definite basis for a scientific approach to the general subject of labor management.

On the other hand, it is probably justifiable to say that out of all this mass of experience there are gradually emerging a number of concrete facts and widely accepted opinions which seem to have been demonstrated as having a more or less conclusive bearing upon their application to labor management problems and which offer much promise for future advancement in the technique of efficient labor control. The available data are largely fragmentary in character, and widely divergent views have been expressed as to the validity of various assumptions and recommendations. The important fact of the matter, however, is that business men in ever increasing numbers are accepting the hypothesis that highly important changes are impending in the practice of handling labor.

Dr. Watkins, in his latest treatise, has approached the general question of labor management with an unusual degree of understanding and thoroughness. Every phase of the subject is completely covered in commendable detail and the several advantages and defects which are involved in each of the various methods and systems now in use are discussed with a remarkable freedom from personal bias or preconviction. The presentation is especially interesting in its manner of treatment, such conclusions as are drawn being logical while convincing, and the entire development of the subject is exceptionally comprehensive and intelligent. The work displays a keen and intimate knowledge not only of the fundamentals of the problem but also of the practical limitations and considerations which add to the complexity of the subject.

The particular value of this elaborate and painstaking analysis lies in the opportunity which it affords for the education of new and junior executives in the proper methods of approach to the personnel problem. It presents for them a compact encyclopedia of information respecting the attitudes and reactions of employees under varying situations and the effective measures which may be taken to modify their objectionable phases and to promote a co-operative spirit on the workers' part.

The importance of the personnel department in industrial plants is properly stressed, the treatment of the questions of wages and hours of work is economically sound and most sensibly discussed and the business advantage of adequate sanitary, health and protective measures is well emphasized. Of particular interest is the chapter devoted to the subject of regularizing employment. No aspect of labor management is so vitally essential from the worker's viewpoint and little progress can be expected in the field of personnel efficiency unless this element of the problem receives intelligent consideration at the hands of the employer. The analysis of the subject of democracy in industrial management is complete in its scope and enlightening in its presentation.

If there is any general characterization which can be applied to this work, it would seem to be that it is one of sound, practical common sense. This book should be placed in the hands of every executive having occasion to handle large groups of laboring men or women.

Domes and Self-Supporting Arch Barreis

REVIEWED BY A. FLORIS

Civil Engineer, Los Angeles, Calif.

DACHBAUTEN: Kragdächer, Schalen- und Rippencuppeln-Bearbeitet von H. J. Kraus und Fr. Dischinger. (Fourth Edition of Vol. 6, Part II, of Handbuch für Eisenbetonbau. E. Emperger, Editor.) Berlin, 1928: Wilhelm Ernst & Sohn. Bound; 7x10 in.; pp. 390; with 584 text illustrations, mostly line cuts. 28 reichsmarks in Germany.

Recent developments in Germany indicate that the future of reinforced-concrete structures depends largely on the use of thin slabs of various types without ribs or other intermediate supporting members. This tendency is not entirely new. At the beginning of the era of reinforced-concrete construction the flat slabs were invented and since then they have been successfully applied. But the curved slabs have found in the last few years a quite different field of application which deserves careful attention.

Until recently reinforced-concrete domes subjected to bending moments were usually divided into meridian and parallel rings supporting the slab of the structure. The theory of the elastic shells was not yet developed to such an extent as to warrant a secure foundation for the design of such structures. A rigorous mathematical analysis of the shells of rotation under bending is now available, although exceedingly complicated and laborious. Nevertheless the approximate method of J. Geckeler, given in this book, is tolerably simple and surprisingly accurate. In addition to this, F. Dischinger and Dr. Bauersfeld devised a method which eliminates these troublesome bending stresses in the shells of rotation. This improvement in the stability of the structure can be easily attained by applying their new method of design, which consists in the choice of suitable boundary conditions in the dome. By changing the radius of curvature of the meridian curve of the shell in the neighborhood of its boundaries the undesirable bending moments

can be eliminated almost completely. This simple change of the radius of curvature makes possible the design of exceptionally thin domes in reinforced concrete. A hemispherical dome, for instance, built recently in Düsseldorf, Germany, has a diameter of 99 ft. and weighs only 13 metric tons!

A manifestly new type of structure, the self-supporting arch barrel invented by Dr. Bauersfeld and Engineer U. Finsterwalder, is fully described in this book for the first time and its analysis is also completely given. The remarkable properties of this new structural element are, from the point of view of theory and practice, extremely important. If an arch barrel of constant thickness is rigidly connected with two strong end disks, then it will behave as a free supported beam of large moment of inertia. By utilizing this hollow arched beam it is possible to cover great spaces without tie-rods, beams or other intermediate supports, as the barrel will carry itself throughout its length between the two end disks. As an example may be cited the Great Public Market of the city of Frankfort-on-the-Main, Germany. This reinforced-concrete arched roof is $2\frac{3}{4}$ in. thick, has a span of 46 ft. and is 121 ft. long. It is supported by four columns only, without beams except the two end disks. The method of analysis of this arched roof is thoroughly treated in this book. These exceedingly thin domes and arched roofs require specially constructed steel falsework, as they are quite sensitive to slight variations in the elevation of the forms. A falsework of this kind was invented by Dr. Bauersfeld, the main design data of which are given by the book under review.

The book as a whole is an epoch-making contribution to the improvement of reinforced-concrete design. It is the most complete discussion on the analysis of domes and of these new arched roofs ever published in any language. It is a treatise for the needs of the practical designer, although its subject matter is necessarily highly mathematical. The results of the theory can be mastered with little effort, and can be easily utilized in given cases. The book should be studied by those interested in progressive and economical design of reinforced-concrete structures.

Publications Received

THE A B C OF AVIATION—By Victor W. Page, Major, U. S. Air Corps Reserve. Paper; 5x7 in.; pp. 143; illustrated, $1.

ANGEWANDTE HYDRAULIK — Von Dr.-Ing. F. Bundschu. Berlin: Julius Springer. Paper; 6x9 in.; pp. 75; 55 line cuts; 16 pp. of tables of values of V and Q for various slopes in Kutter formula, limited to $m = 0.25$ and 0.35 (metric; or, if feet be used, $n = 0.0125$ and 0.0135). 6.9 marks.

BUILDING RESEARCH BOARD (British): Report for 1927—London: H.M. Stationery Office. New York: British Library of Information, 5 East 45th St. Paper; 7x10 in.; pp. 132; illustrated. 3s.

DRUCKROHRLEITUNGEN: Berechnungs- und Konstruktionsgrundlagen der Rohrleitungen fur Wasserkraft und Wasserversorgungsanlagen—Von Dr.-Ing. Felix Bundschu. Zweite, neubearbeitete Auflage. Berlin: Julius Springer. Paper; 6x9 in.; pp. 62; 15 line cuts. 6 marks.

FAILURE OF CONCRETE Under Combined Compressive Stresses: A Study—By Frank E. Richart, Research Professor, Anton Brandtzaeg, Graduate Student, and Rex L. Brown, Research Professor, Department of Theoretical and Applied Mechanics. Urbana: University of Illinois. Paper; 6x9 in.; pp. 102; illustrated. 55c.

Covers (1) concrete specimens loaded in compression in one, in two or in three directions at right angles to each other by means of fluid pressures; (2) plain and spirally reinforced-concrete compression specimens loaded in one direction in the usual manner. Gives the several theories on the subject of combined stress, a description of the materials and testing methods, detailed descriptions of the tests of the concrete in both bi-axial and tri-axial compression, and a general discussion of the condition of the concrete after the tests and conclusions.

FRENCH AND GERMAN INLAND WATERWAYS—By E. T. Chamberlain, Trade Information Bulletin 597, U. S. Bureau of Foreign and Domestic Commerce, Washington, D. C. Paper; 6x9 in.; pp. 12.

FEDERAL AID TO THE STATES—By Austin Macdonald, University of Pennsylvania, Chairman Committee, etc., National Municipal League. Supplement to October issue, *National Municipal Review*, New York City. Paper; 6x9 in.; pp. 51.

A review of the author's book, Federal Aid, appeared in these columns April 19, 1928, p. 635.

FIRE RESISTANCE OF HOLLOW LOAD-BEARING WALL TILE—By S. H. Ingberg, Senior Engineer, and H. D. Foster, Research Associate, Bureau of Standards. Reprint from B. of S. *Journal of Research*, Jan., 1929. Paper; 6x9 in.; pp. 334; halftones and line cuts. 75c. from Superintendent of Documents, Washington, D. C.

GOVERNMENTAL RESEARCH ASSOCIATION: Seventeeth Annual Meeting, October, 1928. New York: Governmental Research Association, 261 Broadway. Paper; $8\frac{1}{2}$x$10\frac{1}{2}$ in.; pp. 151; mimeographed. $2.

GROUNDWATER SUPPLIES OF THE ATLANTIC City Region (N. J.)—By David G. Thompson. A co-operative study by N. J. Department of Conservation and Development and U. S. Geological Survey. Trenton, N. J.: Department of Conservation. Paper; 6x9 in.; pp. 138; halftones and line cuts.

HIGHWAY MATERIALS, Tentative Standard Methods of Sampling and Testing Adopted by the American Association of State Highway Materials and Approved for Use on Federal-Aid Construction. (Revised September, 1928.) Paper; 6x9 in.; pp. 131; line cuts. 50c. from Superintendent of Documents, Washington, D. C.

Covers bituminous, non-bituminous and metallic materials; also drain tile and culvert pipe.

HOW TO EMPLOY AND USE SERVICES OF PRACTICING ENGINEERS: Fees and Professional Agreements; Minimum Recommended Fees; Code of Practice. Chicago: American Association of Engineers. Paper 6x9 in.; pp. 27. $25c.

Prepared by a committee of which Paul Hansen, of Pearse, Greeley & Hansen, Chicago, was chairman.

ILLUMINATION FROM LIGHT COURTS, A Method of Predicting—By K. Y. Tang, Department of Electrical Engineering, Ohio State University. Paper; 6x9 in.; pp. 26; illustrated. 50c. from Director, Engineering Experiment Station, Columbus, Ohio.

THE IMPROVED VENTURI FLUME—By Ralph L. Parshall, Irrigation Engineer, in co-operation with the U. S. Bureau of Public Roads. Fort Collins, Colo.; Colorado Experiment Station. Paper; 6x9 in.; pp. 84; illustrated.

INDUSTRIAL EXPLORERS—By Maurice Holland, Director Division of Engineering and Industrial Research National Research Council, with Henry F. Pringle. New York and London: Harper & Brothers. Cloth; 6x9 in.; pp. 347; halftone portraits. $3.

Popular sketches of 19 "eminent leaders in the field of industrial research" (quoted from jacket) and their work, as a rule in some specialized field. Among those included are Willis R. Whitney, General Electric Company; Samuel C. Prescott, Massachusetts Institute of Technology; F. R. McMillan, Portland Cement Association; C. E. Skinner, Westinghouse Electric & Manufacturing Company, and Charles L. Reese, E. I. du Pont de Nemours & Company.

LEAKAGE FROM HIGH-PRESSURE NATURAL GAS TRANSMISSION LINES—By E. L. Rawlins and L. D. Wosk. Bull. 265, Bureau of Mines. Paper; 6x9 in.; pp. 108; illustrated. 25c. from Superintendent of Documents, Washington, D. C.

LIST OF ENGINEERING ARTICLES [on irrigation and allied subjects] No. 6, superseding earlier lists. Paper; 6x9 in. pp. 46. Free from Bureau of Reclamation, Washington, D. C.

LOW COST IMPROVED ROADS: Report of an Investigation by C. N. Connor. Part II, Proceedings of the Seventh Annual Meeting of the Research Highway Board, December, 1927. Edited by Roy W. Crum, Director. Washington, D. C.: National Highway Research Council. Paper; 6x9 in.; pp. 311; illustrated, chiefly by road cross-sections. $5.

Details and summary of results of four years' investigation on various classes of road surfaces, from sand-clay to bituminous concrete and natural rock asphalt.

MECHANICAL WORLD YEAR BOOK, 1929—Manchester, England: Emmott & Co. Cloth; 4x6 in.; pp. 348 + Diary for 1929; illustrated. 1s.

MEASUREMENT OF PIPE FLOW by the Co-ordinate Method—By F. W. Greve, Professor of Hydraulic Engineering, School of Civil Engineering, Purdue University. Lafayette, Ind.: The Registrar, Purdue University. Paper; 6x9 in.; pp. 31; 7 illustrations.

OPPORTUNITIES FOR ENGINEERS in the United States Civil Service—Including Table Showing Salaries and Distribution of Government Engineers. Washington, D. C.: United States Civil Service Commission. Paper; $3\frac{1}{2}$x8 in.; pp. 43.

OXYACETYLENE WELDING OF STEEL PIPE: Serial Report No. 1, Subcommittee on Pipe Joints, American Gas Association, Inc. (420 Lexington Ave., New York City), O. S. Hagerman, Chairman. Paper; 7x10 in.; pp. 72; halftones and 16 line cuts.

Takes up strength, gives tests, cost data; gives procedure control for welding, for fabricating fittings and describes templet layout.

PLANNING INFORMATION UP-TO-DATE: A Supplement, 1923-1928, to Kimball's Manual of Information on City Planning and Zoning, Including References on Regional, Rural and

National Planning—Prepared by Theodora Kimball Hubbard, Special Adviser to Library, and Katherine McNamara, Librarian, School of Landscape Architecture, Harvard University, Cambridge, Mass.: Harvard University Press. Cloth; 7x10 in.; pp. 103. $2; with Manual, $4.50.

Chiefly a classified bibliography, with American and foreign references. Lists national, state and regional planning organizations, periodicals giving space to planning and zoning. Has subject index; also consolidated author index covering both Manual and Supplement.

PHOTOSTAT RECORDING—By George C. Havenner. New York: Municipal Administration Service, 261 Broadway. Paper; 6x9 in.; pp. 16; 1 halftone. 15c.

Designed primarily for city and other public officials charged with recording public documents, but equally good for others who could or do profit by the use of the photostat.

PORTLAND CEMENT MORTAR, Relation Between Strength and Temperature at Time of Test—By G. A. Parkinson, S. P. Finch and J. E. Hoff. Austin, Tex.: University of Texas. Paper; 6x9 in.; pp. 26; line cuts.

PROCEEDINGS, Sixth Annual Short School, Texas Association of Sanitarians. Paper; 6x9 in.; pp. 188. $1 plus postage from E. G. Eggert, secretary, Capitol Station, Austin, Tex.

PROPAGANDA—By Edward L. Bernays. New York: Horace Liveright. Cloth; 6x9 in. pp. 159. $2.50.

PROPERTIES OF BREEZE AND CLINKER AGGREGATES and Methods of Testing Their Soundness—By F. M. Lea, A.I.C. Bull. 5, Building Research. London: H. M. Stationery Office. New York: British Library of Information. Paper; 7x10 in.; pp. 16. 6d.

PROVER MED MODELLTURBINER for Morkoss-Solbergfossanlegget—Av Professor G. Sundby. Trondhjem, Norway: F. Bruns, Bokhandel. Paper: 6x9 in.; pp. 80; halftones and line cuts, including curves in color. 3.8 kr.

Summary of tests of a model turbine at the plant named.

DIE REICHWEITE VON GRUNDWASSERABSENKUNGEN MITTELS ROHRBRUNNEN: Ein Beitrag zur Theorie und praktischen Berechnung von Absenkungsanlagen—Von Dr.-Ing. Hermann Weber, Siemens-Bauunion, G. m. b. H. Kommanditgesellschaft. Berlin: Julius Springer. Paper; 6x9 in.; pp. 57; 22 line cuts. 4.5 marks.

REINFORCED BRICKWORK—By Mason Vaugh, Agricultural Engineer. Columbia, Mo.: University of Missouri. Paper; 6x9 in.; pp. 84; 68 illustrations and 33 tables.

RESEARCHES ON SPRINGS: 5, Effect of Nip on the Mechanical Properties of Laminated Springs—By R. G. Batson, M.Inst.C.E., M.Inst.Mech.E., and J. Bradley. London: H. M. Stationery Office. New York: British Library of Information, 5 E. 45 St. Paper; 6x9 in.; pp. 38; line cuts. 15d.

ROLLED STEEL PLATES FOR COLUMN BASES: Bearing Plates, Bridge Shoes, Machinery Bases, etc.—Pittsburgh, Pa.: Carnegie Steel Co. Paper; 5x7½ in.; pp. 17, mostly tables. Free.

ROMAN SURVEYING INSTRUMENTS—By Edward Noble Strong. [U. of Wash. Publications in Language and Literature] Seattle: University of Washington. Paper; 7x10 in.; pp. 27; 22 line cuts. 75c.

Interesting short descriptions of "the principal instruments, whether Roman, Greek or Etruscan in origin, used by Roman engineers in land-surveying and leveling, in laying out sites for camps and towns, and in the construction of roads and aqueducts."

THE SANITATION OF BUILDINGS—By E. Thomas Swinson, M. Royal Sanitary Institute, etc. New York: Oxford University Press. Cloth; 6x9 in.; pp. 465; illustrated. $10.

British regulations and practice in considerable detail as regards general sanitation, building sites, natural lighting and ventilation, plumbing and drain (sewer) connections. Brief exposition of sewage disposal. Extensive citations from national and local regulations. Good handbook of British practice. Outside Great Britain and her colonies and dependencies useful chiefly for comparative purposes.

SEASONING, HANDLING AND CARE OF LUMBER: Report of the Distributors Committee of the National Committee on Wood Utilization. Paper; 6x9 in.; pp. 74; illustrated. 20c. from Superintendent of Documents, Washington, D. C.

SEWAGE AND SEWERAGE OF FARM HOMES: Farmer's Bull. 1227, U. S. Department of Agriculture, Washington, D. C. Paper; 6x9 in.; pp. 45; 33 illustrations.

SHIPPING CHARGES at United States and Foreign Ports—Compiled by Corps of Engineers, U. S. Army, and United States Shipping Board. Paper; 6x9 in.; pp. 142. 25c. from Superintendent of Documents, Washington, D. C.

SOUTH AFRICAN RAILWAYS AND HARBOURS: Report for 1927-28—By J. R. More, General Manager, Johannesburg, S. A. Pretoria, S. A.: The Government Printing and Stationery Office. Paper; 8x13 in.; pp. 173; folding maps and plates. 7s.

STAHL UND EISENBETON IM GESCHOSSGROSS bau ein Wirtschaftlicher Vergleich—Von Dr. techn. Gustav Spiegel. Berlin: Julius Springer. Paper; 6x10 in.; pp. 37; line cut and tables. 1.9 marks.

A STANDARD CITY PLANNING ENABLING ACT—By the Advisory Committee on City Planning and Zoning Appointed by Secretary Hoover. Paper; 6x9 in.; pp. 53. 15c. from Superintendent of Documents, Washington, D. C.

STREAM FLOW RECORDS FOR PENNSYLVANIA, 1925-26—Harrisburg, Pa.: Department of Forests and Waters. Cloth; 6x9 in.; pp. 245; maps and tables.

DIE STRENGE BERECHNUNG VON KREISPTATTEN unter Einzell asten mit Hiefe von krummlinigen Koordenaten und deren Anwendung auf die Pilzdecke—Von Dr.-Ing. Wilhelm Flügge. Berlin: Julius Springer. Paper; 6x9 in.; pp. 55; diagrams. 5 marks.

STRENGTH OF MATERIALS—By Alfred P. Poorman, A.B., C.E., Professor of Applied Mechanics, Purdue University, Lafayette, Ind. Second edition. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 343; 214 illustrations, mostly line cuts. $3.

New material in this edition includes articles on form factors of timber beams and on timber columns, besides weights of strengths of timber. Fuller treatment is given to sudden and impact loads on bars and on beams. The chapter on riveted joints has been almost wholly rewritten, as also many of the problems. New problems have been added.

STRUCTURAL WELDING COMMITTEE of the American Bureau of Welding: Report on Pilot Tests at the University of Toronto, 1927-8—By Peter Gillespie, C. A. Hughes, K. B. Jackson and J. H. Fox. Sec. 2, Bulletin 8, School of Engineering Research. Paper; 6x9 in.; pp. 72; illustrations and tables. Also Shear Stress in Certain Thin Fillets, by the same authors, being Sec. 3 of same bulletin. Paper; 6x9 in.; pp. 6, illustrated.

Professor Gillespie states that Sec. 3, "incidentally, is related in a general way to the subject of structural welding."

STUDIENBERICHT ÜBER DIE ABDICHTUNG von wasserdurchlässigem Fels und Mouerwerk in Eisenbahntunnels—Von Prof. K. E. Hilgard. Berlin: Julius Springer. Paper; 6x9 in.; pp. 15.

TESTS ON LUBRICATING OILS—By M. V. Dover, Associate Professor of Chemistry. Columbia, Mo.: University of Missouri. Paper; 6x9 in.; pp. 52; illustrated; plates and tables.

TIDAL BENCH MARKS, State of New Jersey—By L. A. Cole, Associate Mathematician, U. S. Coast and Geodetic Survey. Paper; 6x9 in.; pp. 18. 10c. from Superintendent of Documents, Washington, D. C.

Letters to the Editor

Loudness Scale

Sir—The loudness scale described by Mr. Waterfall in *Engineering News-Record* of Jan. 10 marks a long step forward in the interpretation of data on acoustics for engineers and architects.

The vast literature now in existence on the subject of acoustics and sound deadening is intelligible to physicists and difficult of understanding for many men who would like to make use of it, for the simple reason that all values of sound are expressed in pitch.

I should suggest a modification of the scale illustrated, this modification to consist in placing opposite each sound shown on the loudness scale the value expressed in pitch. This would, immediately, greatly increase the value of bulletins issued by experimental stations and also make perfectly intelligible many articles now in print that deal with acoustics.

New York City, Jan. 22, 1929. ERNEST MCCULLOUGH, Consulting Engineer.

Effect of Temperature on Strength of Concrete

Sir—In the Jan. 31 issue of *Engineering News-Record* Professor Wiley presents valuable data pertaining to the effects of temperatures on the strength of concrete. As stated in his article, the results given are not complete. However, his results indicate clearly along what lines more experimentation is needed and it is to be hoped that he will continue his experiments so as to obtain data from which really definite conclusions may be drawn.

In Fig. 1 of his article, the curve "Steam bath at 205 deg. F." suggests that further studies on the effect of relatively high temperatures at early ages might bring out very useful information. Just why did these specimens increase in strength up to an age of seven days and then decrease in strength?

Fig. 2 is even more interesting than Fig. 1. Doubtless many readers would like to know how near the various

curves would approach one another if extended to ages of three months, six months or a year. Also, if some of the specimens had been kept in a frozen state for periods up to, say, 30 days and then allowed to cure at normal temperatures it might have been found that hydration does take place but at a much slower rate when the concrete is frozen. Professor Wiley concludes that no dependence should be placed in gain in strength of concrete while frozen. I believe that further study is needed to substantiate his conclusion on this point. His curves indicate a slight increase in strength.

There is another phase to this subject that might be worthy of some study. I have known of a few cases where concrete was frozen before initial set could take place and the concrete remained frozen for several weeks. When warm weather finally came the concrete appeared to be sound and still appears so. This is not to be construed as an argument for permitting concrete to freeze, but I believe that experiments along this line would clear up some points.

Let us hope that Professor Wiley will secure more help and a larger refrigerator and get busy.

Ada, Ohio, Feb. 4, 1929. C. C. CARPENTER, Civil Engineer.

Brake Systems and Road Capacity

Sir—Your article on p. 964 of the Dec. 27 issue, "Road Capacity Decreases as Auto Speed Increases," is very interesting indeed, but I am wondering if the data apply to cars with two-wheel brakes or include cars both with two-wheel and with four-wheel brakes. In either case I cannot help but feel that when we arrive at the time when all cars on the road are equipped with adequate four-wheel brakes, especially of the hydraulic type where equal braking effort is normally exerted on all of the wheels (or in some cases of later design where even greater braking effort is exerted on front wheels than the rear wheels), the figures given will be materially altered, and that increased speeds will show an increase in traffic capacity of the highways.

East Pittsburgh, Pa., Jan. 14, 1929. A. M. CANDY, Engineer Westinghouse Electric & Manufacturing Company.

Good Practice in High Dams

Sir—With reference to the papers by A. J. Wiley and D. C. Henny in your issue of Oct. 25, 1928, and more especially to A. H. White's letter in your issue of Nov. 15, may I draw attention to the following:

The whole trend of the papers referred to is toward the conclusion that the direct thrust type of multiple-arch dam is better than existing types. For nineteen years I have been trying to get engineers to see this and at last find that I have at least one supporter in Mr. White, though I do not know that any of his dams really fulfills the desired conditions; indeed, from his reference to the Sherman Island dam, it seems that he is only creeping a little nearer to the logical type, for that dam provides direct thrust only up to 40 ft.

The Arizona dam (Lake Pleasant), now reported to be not deserving of confidence, is another bastard structure, water loads being taken directly only up to 80 ft. in a total of 155 ft. above riverbed.

In 1909 I designed a multiple-arch dam, which I called the thrust buttress type, the actual design, for the Krishna project, being 185 ft. above riverbed; but I recommended the type for heights up to 300 ft. or more, even for wide valleys. I described my design in a "Note on Mass Dams and Dams of Arches," printed by the Madras government, reprinted and circulated by order of the government of India, which had received a favorable report from Professor Warren, of Sydney University, to whom my plans had been submitted for scrutiny. I also described the design in the London *Engineer* of Feb. 24 and March 3, 1911, and in a paper which I read before the Concrete Institute, March 14, 1912. (*Transactions*, p. 146 and p. 299) I called the attention of the editor of *Engineering News* to my invention in a letter published in the issue of July 20, 1911.

In a report to his government Prof. Liugi Luiggi recommended my type of dam as one of the best for a considerable range of heights. I have made no modification in my type design of 1909, the method of calculating masonry thicknesses being the same for all heights. Except in a small portion of the top of the buttress in which some defined least thickness of masonry has to be provided and in a small part of the top of the arch, *the stress is uniform throughout the dam*, or very nearly.

My design is applicable wherever a multiple-arch dam is indicated as suitable except where the natural foundation does not extend far enough downstream even for the spread foundations which my design makes possible on relatively weak downstream strata.

The ruling feature is that the normals from the water face must all fall within the foundations. The masonry of the buttresses is built in courses parallel to the water face. Usually both the buttress tops and the water face are 45 deg. to the horizontal, but, the right angle between them being preserved, the slopes may be altered to suit special cases.

The stresses are all direct compressions, no other stresses being developed.

Very slowly American engineers have been creeping toward the elimination of the weight-moment principle in the design of multiple-arch dams, the attempted combination of which with the thrust principle in the lower part of the dam produces a bastard type the stresses in which cannot be truly calculated even by Swiss engineers, and are relatively high.

Westminster, England, Jan. 29, 1929. REGINALD RYVES, Consulting Engineer.

"Engineering News-Record" Special Highway Issue

Sir—The issue of *Engineering News-Record* of Jan. 3 was most excellent and the manner in which the various writers handled their subjects was instructive and enlightening. I thoroughly enjoyed reading each article and they contained something that road engineers, contractors and others could read many times with profit.

In Mr. MacDonald's article there was a slight error made in regard to the history of the formation of the American Association of State Highway Officials when he said this was brought about by a call issued at the St. Louis meeting. This is not exactly correct. This association was brought into existence by a call issued at Atlanta in the fall of 1914 at the meeting of the American Highway Association and was not fostered by the director of the bureau at that time.

The association was formed and put into active operation at a meeting, in pursuance with the call at Atlanta, held in Washington, Dec. 12, 1914.

This is just to keep the records straight.

Richmond, Va., Feb. 7, 1929. H. G. SHIRLEY, Commissioner, Department of Highways of Virginia.

* * *

Sir—*Engineering News-Record* of Jan. 3, which I have read with interest, is a very fine issue.

Perhaps I did not make my meaning clear in the last paragraph of my article, but as edited it expresses an entirely different thought than I intended. I said:

"The most fallacious of these plans originates in the congestion now existing in metropolitan areas and this traffic is assumed to continue in unbroken numbers from end to end of the continent, thus necessitating great continental routes of four, six or even more lanes. This multi-lane traffic problem lies within metropolitan areas and closely connected large centers of population."

As edited, it reads:

"The most fallacious of these plans originates in the congestion now existing in metropolitan areas and this traffic is assumed to continue in unbroken numbers from end to end of the continent, thus necessitating great continental routes within metropolitan areas and closely connected large centers of population."

You will note that by leaving out a few words, I have been made to say that the assumption that the traffic continues entirely across the continent necessitates great continental routes *within metropolitan areas* and *between large cities*, which means nothing. What I said was that the real traffic problem is in these congested areas and that the fallacious plan assumes the necessity of multi-lane routes from end to end of the continent.

Washington, D. C., Jan. 24, 1929. THOMAS H. MACDONALD, Chief, Bureau of Public Roads.

News of the Week

Bids Called For on Approaches of Kill van Kull Bridge

Proposals for the construction of the 37 piers for the approaches to the Kill van Kull bridge between Bayonne, N. J., and Port Richmond, Staten Island, will be opened by the Port of New York Authority on March 4. The piers, of which there will be eighteen on the New Jersey side and seventeen on the opposite shore of the Kill van Kull, will be of reinforced concrete and will range in height from 20 ft. to 110 ft. The pier contracts will involve totals of 1,150,000 lb. of structural steel, 2,100,000 lb. of reinforced steel and 27,700 cu.yd. of concrete. Each approach will be approximately 1,900 ft. long.

Excavating work is proceeding rapidly in the cofferdams for the two main abutments, and the pending pier contracts will call for completion by Nov. 1 this year in order that the erection of the approach superstructure may be started then. The main arch, with a span of 1,675 ft., will be the longest bridge of its type in the world.

Canadian National Ry. Plans 695 Miles of New Branch Lines

The program of the Canadian National Railway for the construction of new branch lines to be constructed within the next three years as finally arranged to be submitted to Parliament for approval includes a total mileage of 695 miles, mainly in western Canada. Some of these lines are for the general development and opening up of the country, while others are designed to afford economic and operative advantages to the system. The longest of the lines proposed will run for 117 miles from Bonnyville, Alta., to Walburg, Sask., opening up a rich agricultural country. Another line 86 miles in length from Melfort to Aberdeen, Sask., will furnish a direct route to The Pas, Man., which is the initial point of the railway to the northern Manitoba copper-mining area.

Virginia Starts Its 1929 Road Construction Program

As a start on its $10,000,000 program for the year the Virginia State Highway Commission has asked bids for March 4 on $150,000 worth of road and bridge work in five counties. Said Governor Byrd on Feb. 14: "The year will see the greatest road construction program Virginia has ever undertaken." In addition to the completion of a number of important roads, 1,586 miles of new roads will be taken over by the state.

Concrete Control and Road Maintenance Are Discussed by Officials

Atlantic City Convention of North Atlantic States Highway Officials Draws 2,000

MEETING for their fifth annual convention at Atlantic City, Feb. 13-15, approximately 2,000 members of the Association of Highway Officials of the North Atlantic States participated in a program devoted mainly to concrete practices and control and to problems of highway maintenance. About 30 manufacturers and associations were exhibitors at the convention.

Much interest was manifested in the "Report on Specifications and Conditions Governing Modern Concrete Pavements of Proved Durability in the North Atlantic States," presented by James S. Bixby, district engineer, Department of Public Works, State of New York.

In the presentation and discussion of this paper it was brought forth that there is a constant trend toward the use of a uniform cross-section in concrete roads, that machine finishing is being used almost exclusively and that gravel is proving the best material for subgrades. Delaware is the only state represented by the association that prefers hand finishing to machine finishing. Pennsylvania is holding to the thickened edge design in cross-sections, whereas New York is using both uniform and thickened edge sections. The use of expansion joints and reinforcing varies widely among the states. Rhode Island maintains a special school for highway inspectors, which was a subject of much favorable comment.

Wallace F. Purrington, of the State Highway Department of New Hampshire, presented a paper on "Two Years' Experience With the Water-Cement Ratio as Applied to Highway Pavement Construction."

Concrete Control and Road Failures

Pointing out the fact that in the North Atlantic States concrete aggregates have for the past ten years consistently remained standard, R. B. Gage, chief of testing laboratory, New Jersey State Highway Department, in a paper on "Factors That Control the Quality of Concrete Used in Pavement Construction" attributed the failure of concrete roads to other factors than aggregates. Variation of the important factors of concrete control, such as consistency and plasticity, mixing time and the grading of aggregates was given as the chief cause of poor paving. Mr. Gage emphasized density as the most important quality of concrete in paving, taking preference over compressive and tensile strength. Lack of stability of the subgrade is frequently the cause of pavement failures, but this cause is apt to be exaggerated, Mr. Gage declared. He diagnosed the probable cause of failure of several New Jersey concrete roads.

One whole session of the meeting was given over to a discussion of maintenance of concrete roads and repairs made with bituminous materials. Papers on these subjects were presented by Alex W. Muir, superintendent of maintenance, New Jersey State Highway Department; Harry C. Carsten, supervisor of repairs, and George E. Hamlin, superintendent of maintenance, State Highway Department of Connecticut.

Other subjects covered at the meeting included guard rail design, pavement markings and traffic control, ruling grades and curves, culvert loading and concrete paving joints.

Bridge and Tunnel Authority Bill Before New York Legislature

A Bridge and Tunnel Authority bill for the city of New York was introduced in the New York State Legislature Feb. 15. Under the plan proposed the authority, established by the resolution of the Board of Estimate and Apportionment, would consist of three members to be appointed by the Mayor, the Commissioner of Plant and Structures and the chairman of the Board of Transportation of the city of New York. Such authority would have complete supervision to recommend the construction of bridges and tunnels between the various boroughs of the city.

The authority would be empowered to raise money for the construction of bridges and tunnels on its own obligations secured by the pledge of the revenues and tolls from the use of the bridges and tunnels to be constructed.

Special Committee Appointed to Standardize Baltimore Contracts

A special committee of engineers has been named by Mayor William F. Broening, of Baltimore, to undertake the task of standardizing specifications for municipal contract work given out by the Board of Awards. Charles F. Goob, chief engineer of the city, is chairman of the committee. The other members are Milton J. Ruark, sewerage engineer; Edward G. Rost, water engineer; Warren Viessman, electrical engineer; Nathan L. Smith, highways engineer; Herbert J. Leimbach, supervising engineer of the Public Improvement Commission; Elmer E. Hammond, harbor engineer; Walter G. Hammond, buildings engineer, and Ralph C. Sharretts, secretary of the Public Improvement Commission, who will serve as secretary of the new committee.

N. Y. Public Service Commission Reports on Grade Eliminations

Grade elimination legislation was reviewed in the annual report of the New York State Public Service Commission filed with Governor Roosevelt Feb. 14. The commission has designated 245 crossings for consideration on the 1929 program at a total estimated cost of $31,123,700 and continuing proceedings involving 54 crossings on which hearings were held in 1928 but on which no determination was reached.

Twelve crossings have been designated for consideration in Buffalo in 1929, at an estimated cost of $8,755,000.

Since the law under the $300,000,000 bond issue was enacted in 1926, 624 proceedings have been started for elimination involving the elimination of 1,009 crossings. There have been held 1,292 hearings and 311 orders have been issued involving the elimination of 480 crossings. There have been 350 orders issued closing proceedings involving 455 crossings and there have been eliminated to date 105 crossings.

Steel Fabrication Begun on Chicago Merchandise Mart

More than 33,000 tons of steel has arrived in Chicago to be used in the construction of the huge Merchandise Mart building, and the steel is now passing through the fabricating shops of the McClintic-Marshall Company. The first of the steel, consisting of the slabs to be placed over the 558 reinforced-concrete caissons now completed, has been taken to the site of the building at Wells St. and the Chicago River and construction is now in progress. It is believed that there are two times as many caissons utilized in this foundation as have ever been used in a single building. Also, according to Magnus Gunderson, chief structural engineer for Graham-Anderson-Probst & White, architects, 33,000 tons of steel represents the largest tonnage ever assembled in a single yard. With the completion of the caisson work, it is estimated that about $1,600,000 has been expended for the preliminary work and underground construction on this $30,000,000 project.

Pan-American Highway Congress at Rio de Janeiro in June

The second Pan-American Congress of Highways will convene at Rio de Janeiro, Brazil, June 19, 1929, and will end July 1. The object of the congress is the study of methods and systems for the co-ordination of efforts relating to the construction, operation, maintenance and financing of highways. The program has been divided into five sections, as follows: technical methods of construction and maintenance of all classes of improved highways; traffic control and operation; legislation, administration, finance and economy; international and Pan-American agreements; and publicity, education and miscellaneous subjects.

Canadian Engineers Elect C. H. Mitchell President for 1929

Former Member of St. Lawrence Board New Head of Engineering Institute of Canada

CHARLES H. MITCHELL, consulting engineer, Toronto, Ont., was elected president of the Engineering Institute of Canada at the opening session of the 43d annual meeting of the Institute held at Hamilton, Ont., Feb. 13-15.

CHARLES H. MITCHELL

General Mitchell is a native of Petrolia, Ont., where he was born Feb. 18, 1872, and is a graduate of the University of Toronto in the class of 1892. In 1898 he received the degree of civil engineer from the same university. Since the early days of his professional career General Mitchell has been in close touch with developments at Niagara Falls and along the St. Lawrence, first as assistant city engineer at Niagara Falls, N. Y., and then as city engineer of Niagara Falls, Ont., from 1894 to 1900. In 1901 he became principal assistant engineer of the Ontario Power Company, which position he held until in 1906 he went to Europe to study hydro-electric power development there. From 1906 to 1914 he was in private practice in Toronto, specializing in hydraulic and hydro-electric power development. During this time he served as consulting engineer to the Ontario Power Company for part of two years and subsequently as consulting engineer to the water-power branch of the Department of the Interior of the Dominion of Canada on water power and conservation in western Canada. After the war he devoted some time to the same work.

General Mitchell's military record began in 1899 when he joined the Canadian militia and continued to the outbreak of the World War, when he went to France with the Canadian Expeditionary Forces and served for five years on the general staff (intelligence) in France, Belgium and Italy. He was promoted to the rank of brigadier general in October, 1918. For this service he was decorated by Great Britain, France, Belgium and Italy.

After the war General Mitchell returned to Toronto to become dean of the faculty of applied science and engineering of the University of Toronto. In 1924 he was appointed a member of the Joint Board of Engineers (Canada and United States) to study and report on the St. Lawrence waterway project for navigation and power.

General Mitchell is a member of the Institution of Civil Engineers, London, and the American Society of Civil Engineers. He is the author of a number of books and articles on aviation and hydraulic power.

Technical Session

Part of each the three days of the meeting of the Engineering Institute of Canada was given over to the presentation of reports and technical papers. Subjects of special interest to the civil engineering field were a paper on the St. Lawrence Problem—Some Canadian Economic Aspects, by L. R. Thomson, consulting engineer, Montreal; a paper on highway maintenance, by R. M. Smith, Deputy Minister of the Ontario Department of Public Highways; Intakes in Lake Ontario for the City of Hamilton Water Supply, by H. S. Philips and James Stodart, of the city engineer's office of Hamilton; a paper on the Chlorination of Sewage, by L. H. Enslow, research engineer of the Chlorine Institute, New York; and the Importance of Geology to Engineering Work, by H. Ries, professor of geology, Cornell University.

Great Northern and Western Pac. Plan 200-Mile Extensions

Extension of the Great Northern Railway from Klamath Falls, Ore., into California to connect with a proposed northerly extension of the Western Pacific from Paxton or Keddie, Calif., is proposed in an application filed with the Interstate Commerce Commission on Feb. 14.

The Great Northern proposes to build approximately 80 miles of new line south from Klamath Falls to Lookout, Modoc County, Calif., while the Western Pacific will build about 120 miles of railway north from the Paxton or the Keddie station on its main line.

According to the application, three new trade arteries would be created by the extensions. A second rail link between San Francisco and Portland would be formed. A direct rail link between San Francisco, Spokane and the inland northern tier of states would be created, which would shorten the existing rail distance between Sacramento and Spokane by 120 miles. A third and more direct rail route would be formed between the Pacific Northwest and the states in the lower Mississippi Valley.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Chicago Opposes Niagara Treaty—Engineering Study of Traffic—U. S. Topographic Map Is Slighted

PROMPT ratification of the Niagara remedial works treaty with Canada is being opposed in the Senate by Chicago interests, it has been disclosed. The position of the Illinois Senators and Representatives on the matter, as expressed by Senator Deneen, is that it would be better to withhold approval of the Niagara treaty until negotiations for the St. Lawrence project and the Illinois waterway are completed.

The opinion exists among some of the Illinois delegation, however, that the treaty for the preservation of Niagara Falls that is now being considered by the Senate foreign relations committee would result in a lowering of lake levels, if its terms were carried out. Those holding this view believe that the diversion of 20,000 additional second-feet from the Niagara River for power purposes on both sides of the border would increase materially the flow from Lake Erie. This apprehension is discounted by army engineers.

Traffic Problems

An effort to bring engineering principles to bear on the problem of highway congestion, with particular reference to the relative services performed by the various types of vehicles, is being made in connection with the comprehensive study of the transportation situation in the various cities now under way by the Chamber of Commerce of the United States. Although there has been much discussion of the traffic problem, it is felt that not much has been done toward studying the composition of traffic itself. Traffic engineers believe that much confusion results from a lack of definite limitation to the special privileges extended to certain types of public vehicles such as street cars and buses, and to a somewhat lesser degree to commercial vehicles. Were public vehicles to have their peculiar requirements provided for by actual agreement rather than by the present system of excepting them by tacit understanding from existing rules, it is felt that all concerned would benefit.

U. S. Topographic Map

Failure to appropriate the amounts authorized by the Temple act for the completion of the topographic map of the United States has already resulted in large losses, the committee of mines and mining of the Senate was told on Feb. 15 by representatives of the Association of American State Geologists and by W. C. Mendenhall, chief geologist of the U. S. Geological Survey.

The committee is trying to learn why such relatively small appropriations are allowed for research work and economic studies of value to the mining industry, when fundamental problems such as the conservation of wasting assets of petroleum, metals and other minerals are involved. The committee was told that it would take a hundred years to complete the map at the present rate of progress. Questioning brought out that only insignificant increases had been allowed for the work, despite the fact that Congress, in the Temple act, had authorized much larger amounts with the intent of expediting the work.

Water-Works Purchase Postponed at Davenport, Iowa

Purchase of the property of the Davenport Water Company by the city of Davenport, Iowa, has been authorized by the state legislature. The company has waived a provision in its charter which would have made purchase impossible until eleven years hence and has agreed, in consideration of the adoption of new water rates, that it will sell its property to the city for $2,900,000, as of Jan. 1, 1929, or at an appraised value at the time of purchase. The City Council has decided to wait at least six months before submitting the purchase of the works to popular vote, thus giving time to get the reaction of the public to the present water rates. Harold Metcalf is Mayor of Davenport.

Brief News

Under the Provisions of a bill introduced in the New York State Senate Feb. 14, the labor law is amended by providing that all scaffolding and staging for erecting, repairing, painting, cleaning or pointing a building must be of fireproof material.

The Secretaries of War, Agriculture and Commerce have approved plans of W. D. Comer and Wesley Vandercook for the short spans and tower of the proposed bridge across the Columbia River between Longview, Wash., and Rainier, Ore. Approval previously had been given to plans for the piers, general plans and location.

Proposal That Future grade-crossing eliminations in New Jersey be paid for on a 50-50 basis by the railroads involved and the state or its political subdivisions has been made to Governor Larsen by W. W. Atterbury, president of the Pennsylvania Railroad, and R. B. White, president of the Central Railroad of New Jersey.

Under the Provisions of a bill introduced in the New York State Assembly, Feb. 13, section 94 of the railroad law is amended by providing that all provisions of law applying to performance of public work shall apply also to grade-crossing elimination work, contract to be awarded to lowest bidder of approved financial ability and professional capacity.

Letter Ballot Upholds N.E.W.W.A. Committee on Cross-Connections

Four Given Honorary Membership—Two Papers on Granville Earthfill Dam

ALMOST unanimous support of those voting on the recommendations of the cross-connections committee of the New England Water Works Association was shown by the letter ballot on the subject, announced at the luncheon meeting of the association on Feb. 13. The vote was 304 for to 26 against, with about half of the active membership voting. The resolutions in full, together with excerpts from the report, dissents from two of the members of the committee and from the floor at the meeting held Dec. 12, 1928, were given in *Engineering News-Record*, Dec. 20, 1928, p. 924, and were commented on editorially on p. 905 of the same issue. Protests on the editorial comments, by the chairman and secretary of the committee, appeared on p. 78 of the issue of Jan. 10, 1929.

At the meeting on Feb. 13 honorary membership in the N.E.W.W.A. was conferred on F. A. McInness and H. P. Eddy, consulting engineers, Boston; C. M. Saville, general manager and chief engineer of the Hartford waterworks, and H. W. Clark, chemist, Massachusetts Department of Health and director of the Lawrence experiment station.

Granville Dam Described

Papers upon the Granville earthfill dam, under construction as an addition to the municipally owned water-works of Westfield, Mass., were presented by C. A. Farwell and E. B. Myott, of Fay, Spofford & Thorndike, Boston, consulting engineers on this work. The dam has a maximum height of 80 ft., is of conventional cross-section, with grouted concrete cutoff, on rock, about 10 ft. high. It will contain about 240,000 cu.yd. of earthfill and 30,000 yd. of rockfill at the downstream toe—the total fill costing about 85c. per cubic yard. A concrete spillway 60 ft. long was built at one end of the dam, discharging into a paved spillway channel. The reservoir will be partly stripped, around the flow line, and will have a capacity of about 500 m.g., affording a dependable yield of 4 m.g.d. from a drainage area of 6.4 square miles. Its total cost will be about $630,000, or some $1,260 per million gallons. Work began late in 1927 and completion is expected by Oct. 31, 1929.

Dr. Charles Terzaghi, professor of foundation engineering at the Massachusetts Institute of Technology and consultant upon soil mechanics and geological features, described the conditions and necessary permeability tests made to determine that undue leakage would not occur through an esker delta lying on the westerly side of the reservoir.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

NATIONAL DRAINAGE CONGRESS, Kansas City, Mo.; annual convention, Memphis, Tenn., Feb. 19-21.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; annual convention, Chicago, March 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Dallas, Tex., April 24-26.

* * * *

THE BALTIMORE SECTION, Am. Soc. C.E., held a joint meeting with the Engineers Club of Baltimore at the rooms of the club on the evening of Feb. 15. The activities of the Department of Public Works of the city of Baltimore were discussed by Nathan L. Smith, highways engineer; Warren Viessman, mechanical-electrical engineer; C. K. Allen, acting head, Bureau of Street Cleaning, and Milton J. Ruark, sewerage engineer. The discussions were illustrated with lantern slides, showing recent work done by the city and methods followed by the various bureaus.

THE SOUTHEASTERN WATER AND LIGHT ASSOCIATION, a section of the American Water Works Association, will hold its next convention April 15-17, at Birmingham, Ala.

THE ENGINEERS CLUB of Lincoln, Neb., recently heard an illustrated talk on the architecture of the Nebraska State Capitol given by W. L. Younkin, superintendent of construction for the State Capitol Commission. Officers of the club for the new year are: president, A. W. Andrews; vice-president, R. O. Green, secretary-treasurer, K. L. Bonebright.

THE NEW JERSEY SEWAGE WORKS ASSOCIATION, the engineering bureau of the New Jersey State Department of Health co-operating, will hold its fourteenth annual meeting March 22 and 23 at Trenton, N. J.

Personal Notes

W. M. ROSEWATER, of Cleveland, Ohio, will spend a month or two in San Francisco supervising the designing of two 6-ft. placer-mining dredges that are to be built by the Bethlehem Shipbuilding Corporation, Ltd., for the Fairbanks Exploration Company, of Fairbanks, Alaska.

FRANK E. WEYMOUTH, former chief engineer of the U. S. Reclamation Service, has been appointed assistant chief engineer of the Los Angeles Bureau of Water Works and Supply, in which capacity he will serve under H. A. Van Norman, recently made chief engineer and general manager, succeeding William Mulholland. To accept the new position in Los Angeles, Mr. Weymouth resigns from the J. G. White Engineering Corporation, for which he has had charge of a large irrigation contract being executed by that company for the Mexican government. Mr. Weymouth is a graduate of the University of Maine, class of 1896, and was connected with the United States Reclamation Service from its organization in 1902 until 1924, during the last four years of this period as chief engineer. He has many achievements in the service to his credit, the most outstanding of which is the construction of the Arrowrock dam in Idaho.

HAROLD W. BATES has become associated with the Forest City Testing Laboratory Company, of Cleveland, Ohio, as a member of the firm and will be vice-president in charge of the company's new branch in Detroit, Mich. Mr. Bates was with the Pittsburgh Testing Laboratory for twelve years, part of this time in charge of its Cleveland office, and for seven years was in charge of the laboratory's operations in New York City.

JOSEPH H. WHITE has been elected city engineer of the city of Woonsocket, R. I., to fill the vacancy caused by the death of Frank H. Mills.

LOUIS R. MILLER has recently taken charge of all construction of the new Curtiss Aeroplane & Motor Company plant at Buffalo, N. Y., contract for the erection of which is held by James Stewart & Company, Inc., of New York. This plant covers 60 acres of land. Mr. Miller was in charge of the Vanderbilt Ave. and Depew Place viaducts, New York City, in 1927 and 1928 and the Mitsui Main Bank foundations, Tokyo, Japan, in 1926.

PHILIP L. VOSS has resigned as construction engineer with Warren & Arthur Smadbeck, Inc., New York, and has opened an office in Summit, N. J.

Cost and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Feb. 1, 1929		**210.40**	**January, 1929**		**325**
Jan. 1, 1929		209.40	December, 1928		244
Feb. 1, 1928		204.65	January, 1928		208
Average, 1928		206.78	Average, 1928		287
Average, 1927		206.24	Average, 1927		263
1913		100.00	1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Feb. 18, with some comparisons, total as follows:

(In Thousands of Dollars)

	Feb. 18, 1929	Feb. 11, 1929	Feb. 20, 1928
Building:			
Industrial	$5,354	$11,625	$2,882
Commercial	48,074	70,646	49,437
Streets and roads	2,346	2,161	5,507
Other eng. constr.	10,417	4,597	5,107
Total	$66,191	$89,029	$62,933
Total, all classes, Jan. 1 to Feb. 18:			
1929			$699,280
1928			416,273

ROBERT HOOKE, former city engineer of Chattanooga, Tenn., received, on Feb. 12, the service award for 1928 presented by the Kiwanis Club of that city. Mr. Hooke voluntarily retired from the office of city engineer on June 30, 1928, after 38 years in the service of the city.

THOMAS S. GRIFFIN, for many years in engineering service of New York City on its municipal construction work and with private corporations on engineering and building construction, has been appointed engineer of the Standard Surety & Casualty Company of New York. He will serve in the surety department, associated with John R. English, vice-president, and give particular attention to engineering and building construction features of work on which applications are sought for construction contract bonds.

E. GUY DOANE, village engineer of Seneca Falls, N. Y., for the past three years, has resigned, to take effect April 1.

W. C. BICKFORD has been elected president of the Seattle (Wash.) Construction Council. H. L. NELSON was chosen vice-president and C. J. O'SHEA secretary.

Obituary

HERBERT R. WILSON, 42, former state highway commissioner of Arkansas, died in Little Rock, Feb. 4, following an illness of several weeks. Mr. Wilson served three terms as commissioner and previously as county clerk of Hemstead County and state railroad commissioner. He served as highway commisioner until Jan. 1, 1927. It was during his administration that the road district plan was replaced by the statewide system. In 1915 has was made secretary of the Arkansas Railway Commission and later was elected a member of that body.

LEON V. SHEARER, formerly construction superintendent of the Lehigh Valley Railroad and later active in mining in Utah and Colorado, died in Los Angeles, Calif., recently, aged 54 years.

SILAS S. FEETER, former city engineer of Little Falls, N. Y., died at his home in that city on Feb. 8. He was a graduate of the Sheffield Scientific School of Yale University in the engineering course. For some time he was connected in an engineering capacity with the government in the Philippines. He served three different times as city engineer of Little Falls.

WALTER FREEMAN BROOKS, senior highway engineer in the U. S. Bureau of Public Roads, who had general charge of federal aid road work in Michigan since 1918, died in Chicago on Feb. 7, aged 68. During the war Mr. Brooks was assigned by the bureau to supervise the road work at Camp Taylor. He was a past-president of the Minnesota Society of Surveyors and Engineers.

Construction Equipment and Materials

New Developments

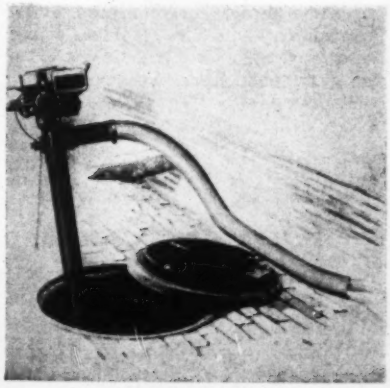
New Crawler Unit for Tractor Attachment

Supplementing the present Trackson Model DH full-crawler for use with the McCormick-Deering industrial tractor, a new model, known as LH, is now being built for use with the same motive power under easier conditions where speed is essential. It is particularly

recommended for road work and general construction purposes. The tractor and attachments weigh 3 tons, contrasting with the 3½ tons of the Model DH. Although built to the usual Trackson design, the new crawler unit incorporates a number of new features, including bushed track shoes, inverted manganese driving teeth on the rear sprockets, a new truck-wheel bearing construction and greater wearing surfaces on the truck wheel and track. A heavy electric-steel front bolster casting is attached to the front of the tractor with specially heat-treated bolts, making it easy to attach front-end equipment rigidly by means of 1-in. capscrews.

New Sump Pump Operated by Outboard Motor

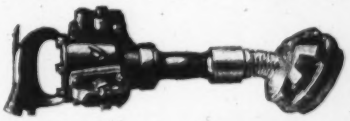
Features of a new portable sump pump powered with an outboard motor are that it is self-priming and will shut itself off when the water supply fails. It is being manufactured by the Johnson Motor Company, Waukegan, Ill. The



pump consists of a long shaft with a light twin-cylinder outboard motor mounted on its top and connected to the impeller at the bottom of the shaft. When water is not passing through the pump a safety device short circuits the magneto of the motor and shuts it off. It is said that it will pump 195 g.p.m. and 1,000 gal. for the approximate cost of one cent. The pump outfit weighs 85 lb. No greasing or special lubrication is required, the motor being oiled by the gasoline mixture. The graphite bronze bearings which support the drive shaft also are lubricated from the drip of the motor. The motor is cooled by special pressure vacuum system. Water is forced by the impeller through a 100-mesh carburetor screen up the spiral seamless copper tube to the motor, where it cools the side walls and heads of the cylinder. It is then pulled down and discharged by a 12-lb. suction created by the action of the impeller. The pump is made in three different lengths, 8, 11 and 14 ft. to suit varying conditions.

New Air Machine for Surfacing Concrete

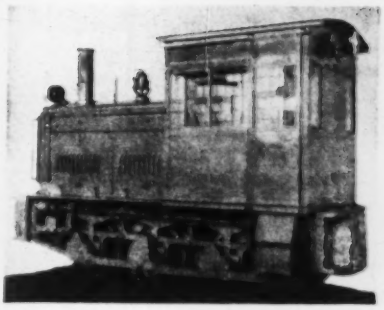
For finishing and smoothing concrete, eliminating form marks, finishing and polishing marble, granite and similar materials, the Chicago Pneumatic Tool Company, New York City, has developed a new surfacing tool known as its



Model 33. There are three major assemblies on the tool—the housing, the cylinder and the live air grip handle. The machine has three cylinders placed 120 deg. apart. Pistons and toggles are of the pin type and a centrifugal ball check vent tube is used. When the machine is at rest the ball check is seated, preventing the loss of lubricant. Among the attachments available for the tool are a coarse grinding wheel, a cutting attachment and a grinding wheel for use on green concrete. The weight of the machine is 15½ lb.

New Locomotive Mounted on Six Drive Wheels

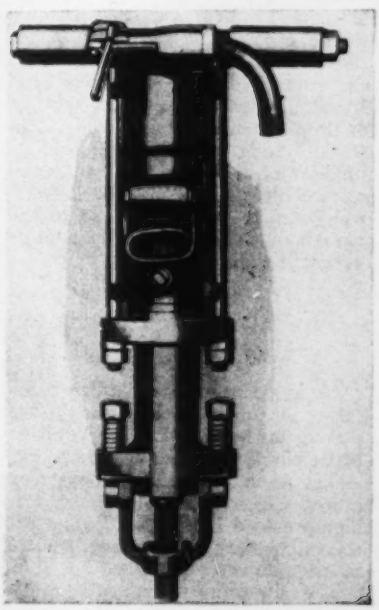
A 20-ton six-wheel gear-and-side-rod drive locomotive for industrial hauling and switching has been developed by the George D. Whitcomb Company, Rochelle, Ill. There is claimed to be an advantage gained by the use of six-wheel mounting because it gives a very even distribution of weight and can be operated on tracks that are not in perfect condition or are laid on soft ground. The locomotive is full gear driven, transmitting the power to the wheels through side rods. It is equipped with standard airbrake equipment.



New Line of Air Drills

A new line of Jackhamer drills perfected by the Ingersoll-Rand Company, New York City, consists of three machines weighing 43, 57 and 72 lb. respectively. All three drills are almost identical in construction and emphasize such features as: Elimination of valve chest on side of cylinder; a special "flapper" valve; throttle in the handle; bushed-type rotation sleeve; swivel air connection; and a new-type steel holder that eliminates wear on the front head.

Each of the two smaller sizes of the machines is made in three types: (1) dry—for the general run of outdoor drilling; (2) wet—for most mining work and shaft sinking and also other drilling in damp ground where water will help to wash out cuttings; and (3) blower tube—for use in deep-hole work in soft, heavy ground where continuous blowing at full-line pressure is needed to clean the hole of cuttings. The largest drill is made in the wet and blower types only. As each drill is designed for a particular class of work, the Ingersoll-Rand Company strongly recommends that the proper drill be



selected for the work in hand, so that the greatest possible economy will be secured. For example:

The 43-lb. machine will find its widest application where a light-weight tool is desired in general excavation, road-building, general mine and quarry work in softer rocks, and "pop-holing" in the hard-rock quarries.

The 57-lb. drill is especially adapted to general excavation and road work, mine and quarry work and shaft-sinking. It is powerful and economical, and its 57 lb. is all essential weight.

The heaviest of the Jackhamer drills, that weighing 72 lb., is recommended for heavier work than the 57-lb. machine, being designed primarily for deep, down-hole work, both in shaft sinking and in quarry bench work.

A New Half-Yard Full Revolving Excavator

A light half-yard excavator, crawler-mounted and full-revolving, has been developed by the Bay City Dredge Works, Bay City, Mich., and designated as its Model K. The tail swing of 7 ft.

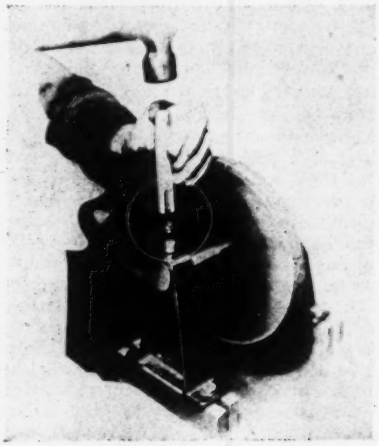
on this machine is claimed to be shorter than that of any full-revolving shovel. A unit manganese-steel casting car body is a feature of the machine. All shafts on the upper rotating base are mounted on roller or ball bearings. The power plant is a McCormick-Deering 35 h.p. four-cylinder engine. Foot brakes are used for all operations and a three-lever hand control is used.

The capacity of the machine as a shovel clamshell or trencher is 3/8 cu. yd. Trench hoes are available in 15-, 18-, 20-, 24- and 30-in. widths with solid or drop bottoms, and a backfiller bucket 48 in. wide can be supplied. The machine is also convertible to dragline service utilizing a ½-yd. bucket. The weight of the machine is 13 tons. It has an over-all width of 8 ft. and an over-all height of 10 ft.

New Lubrication Fitting for Open Oil Holes

As a means of standardizing lubricating methods on old machines—replacing oil holes, grease cups, oil cups, bottle oilers, etc., with a common fitting—the Alemite Manufacturing Corporation, Chicago, has developed a new high-pressure lubrication fitting which it is claimed can be permanently installed in less than two minutes.

The new fitting is known as a driven fitting inasmuch as it is applied with a hammer and special punch tools. No threading is necessary. The first operation consists of driving a reverse feather-edged bushing into the open oil hole. This bushing is in place in the accompanying illustration. Into the top of the bushing a nipple with dirt-proof



ball check valve is installed, as shown in the illustration. An ordinary hammer and a set of three special drive tools form the complete equipment. The bushings are made in 64-in. sizes from ⅛ to ½ in. Special bushings are available for countersunk holes and for thin housings.

Business Notes

GEORGE HAISS MANUFACTURING COMPANY, INC., New York City, announces the appointment of the following new distributors: Holmes-Talcott Company, East Hartford, Conn., and West Springfield, Mass.; Contractors - Equipment Company, Fort Wayne, Ind.; W. C. Caye & Company, Atlanta, Ga.; C. Taylor Handman Company, Cincinnati.

LADD EQUIPMENT COMPANY has recently been formed with general offices in the Farmers Bank Building, Pittsburgh, Pa., to act as sales engineering representative for a limited number of companies, largely in the materials handling field. George T. Ladd is president and treasurer, Robert E. Chew vice-president and general manager, George F. Bright, Jr., secretary, and James H. Burke sales manager.

STANDARD PAVING, LTD., Ottawa, Canada, has announced that negotiations have been completed for merging with Consolidated Sand & Gravel, Ltd., of Toronto. The new company will be known as Standard Paving & Materials, Ltd., and will have a capitalization of $6,000,000. It is the intention of the new company to extend its operations by the purchase of two or possibly three other companies.

WESTINGHOUSE LAMP COMPANY, East Pittsburgh, Pa., announces the association with its commercial engineering department of Arthur J. Sweet, formerly in consulting practice in Milwaukee, Wis. There will be initiated under Mr. Sweet's immediate direction a broadened program of service in the development of street-lighting business and business-building possibilities for the central station.

AMERICAN HOIST & DERRICK COMPANY, St. Paul, Minn., announces that Arthur Harvey, formerly district engineer of the Missouri, Kansas & Texas Railway at Muskogee, Okla., has taken a position in its sales department to specialize in railroad sales out of the Chicago office. Mr. Harvey graduated in civil engineering at the University of Kansas and before becoming connected with the M.K.&T. in 1916 had engineering experience with various Southwestern railroads.

UNIVERSAL PORTLAND CEMENT COMPANY, Chicago, a subsidiary of the United States Steel Corporation, announces the appointment of Murray N. Billings as Western traffic manager in Chicago and Frank E. Guy as Eastern traffic manager in Pittsburgh. In this position and also as traffic manager of the Illinois Steel Company Mr. Billings succeeds F. T. Bentley, who has been connected with subsidiaries of the steel corporation for 35 years and with the organization of the cement company since 1906. Mr. Guy succeeds L. C. Bihler, who also is traffic manager of the Carnegie Steel Company and who has been made assistant to the president and general traffic manager of that company. Mr. Guy has been assistant Eastern traffic manager of the Universal company since 1912.

LOCKSTRIP MANUFACTURING CORPORATION, 3609 Vernon Boulevard, Long Island City, N. Y., has taken over the manufacture and sale of the Lockstrip department of the Traitel Marble Company, Long Island City. The company will manufacture strips (brass and other metal) for use on terrazzo, cement and composition floors to form ornamental outlines and expansion joints. The strip has horizontal flanges to prevent settlement and lifting and also has perforations to allow the continuity of bind, thus forming a locking device. Another new product of the company is a strip to be inserted in the cement finish of floors to form a flush joint for expansion and ornamental purposes, replacing the old scoring method. James G. Collins, who has previously been associated with George A. Fuller Company, Portland Cement Association and the Concrete Surface Corporation of New York, is in charge of sales.

Manufacturers and Trade Associations

CALENDAR

Annual Meetings

NATIONAL RAILWAY APPLIANCES ASSOCIATION, INC., Chicago; 21st annual exhibition, Coliseum, Chicago, March 4-7.